

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

OCTOBER, 1941.

I.—SUB-ATOMICS.

Properties of the witch of Agnesi. Application to fitting the shapes of spectral lines. R. C. Spencer (*J. Opt. Soc. Amer.*, 1940, **30**, 415—419).—Mathematical. The properties of the curve $y = ha^2/(a^2 + x^2)$, which approximates to the energy distribution in spectral and particularly X-ray lines, are described. O. D. S.

Electrical discharges from pointed conductors. J. Zeleny (*J. Franklin Inst.*, 1941, **232**, 23—37).—A review. The general properties of discharges from points are considered. The behaviour of discharges near the breakdown potential is discussed, the differences between negative and positive discharges under these conditions being pointed out. The action of point Geiger counters is discussed. The appearances of positive and negative discharges from points are quite different. Positive discharge currents in air and H₂, but not in N₂, show irregular high-frequency variations of considerable magnitude. In the initial stages of positive currents from points, the discharges consist of isolated bursts, the current in each burst having apparently the same type of fluctuation as is observed at higher voltages when the current appears continuous. This has been re-examined, and the discontinuity in the current-voltage curve near the onset of positive discharges is attributed to the galvanometer formerly used. The effect of artificial ionising sources on point discharges is considered. When a strong radioactive source was brought up to a positively charged point a considerable current could be made to flow before the min. starting potential was reached; the current disappeared altogether when the source was removed. Above the min. potential the current continued to flow after removal of the source, but fell to the val. it would have had in the absence of the source. The magnitude of the current is, therefore, not controlled solely by space-charge effects. For a negatively charged point, the saturation current due to the production of ions by the radioactive source remained const. as the potential of the point was raised, until at a certain val. it increased by a factor of 100 or more. The voltage at which this occurred depended on the no. of ions introduced. The difference in the effect for negative and positive points is explained. A. J. M.

Mechanism of electrical discharges in gases of low pressure. M. J. Druyvesteyn and F. M. Penning (*Rev. Mod. Physics*, 1940, **12**, 87—174).—A summary. W. R. A.

Ions in gases. J. Zeleny (*Science*, 1941, **93**, 167—172).—An address. L. S. T.

Discharge of the particles of an aerosol in a dipolar ionic atmosphere. N. Tunitzki, V. Sarinski, and J. Petranjov (*Acta Physicochim. U.R.S.S.*, 1940, **13**, 327—346).—It is shown theoretically that the discharge follows the law $z_t = z_0 e^{-\rho t}$, where z_0 and z_t are the initial charge and charge after time t , respectively, and ρ is a const., \propto the ionic concn. but independent of the radius of the particle. The law has been confirmed experimentally and the observed val. of ρ has been found to be of the same order of magnitude as the theoretical val. J. W. S.

Ring discharge. C. G. Smith (*Physical Rev.*, 1941, [ii], **59**, 997—1004).—An e.m.f. of 890 cycles per sec. was used to energise a ring discharge in Hg vapour at $\sim 2 \times 10^{-4}$ mm. pressure. Probe experiments show a true electronic temp. of $\sim 300,000^\circ$ K. at the peak of the wave of energisation. Only 13% of the atoms were ionised at the max. of the cycle of ionisation. Strong lines of Hg I, II, III, with faint lines of Hg IV, were observed. The forbidden line $1^1S_0-2^3P_2$

was definitely, and the forbidden line $1^1S_0-2^3P_2$ possibly, observed at the highest electronic temp. only. A probable rate of ion production in an electronic atm. of given density and temp. is calc. To explain the observed limitation of degree of ionisation, a hypothesis involving recombination of ion and electron with conservation of electrical energy is given. N. M. B.

Resistivity of interstellar space. F. L. Mohler (*Physical Rev.*, 1941, [ii], **59**, 1043).—Under the conditions postulated by Evans (cf. A., 1941, I, 95) the collision radius for a collision of an electron with a positive ion is 50×10^{-8} cm. so that the scattering by neutral atoms is entirely negligible. The mean free path is $\sim 5 \times 10^{12}$ and not 10^{16} cm. The resistivity calc. from the equation for an ionised gas is 0.2 ohm-cm.

Time lags in Geiger-Müller counter discharges. C. G. Montgomery and D. D. Montgomery (*Physical Rev.*, 1941, [ii], **59**, 1045; cf. A., 1940, I, 594).—Observed time lags were attributed to the capture of the electrons of the primary ion pairs, forming negative mol. ions which moved relatively slowly into the region of the counter wire. Experiments are described supporting this explanation and measuring the capture probabilities. The estimated capture cross-section of an electron by an O₂ mol. is $\sim 10^{-18}$ sq. cm. (cf. Rose, A., 1941, I, 306). N. M. B.

Acceleration of electrons by magnetic induction. D. W. Kerst (*Physical Rev.*, 1941, [ii], **60**, 47—53).—Apparatus with which electrons were accelerated to 2.3 Me.v. energy by means of the electric field accompanying a changing magnetic field is described. Stable circular orbits are formed in a magnetic field, and the changing flux within the orbits accelerates the electrons. As the magnetic field reaches its peak val., saturation of the Fe supplying flux through the orbit causes the electrons to spiral inwards towards a W target. The X-ray intensity produced is approx. that of the γ -rays from 1 g. of Ra, and, because of the tendency of the X-rays to proceed in the direction of the electrons, a pronounced beam is formed. N. M. B.

Electronic orbits in the induction accelerator. D. W. Kerst and R. Serber (*Physical Rev.*, 1941, [ii], **60**, 53—58).—Mathematical. The principles of operation of the electron induction accelerator (cf. preceding abstract), and an analysis of the electron orbits with reference to the design of the accelerator, are given. N. M. B.

Mechanical model for the motion of electrons in a magnetic field. A. Rose (*J. Appl. Physics*, 1940, **11**, 711—717).—A gyroscope mounted with its axis in the direction of the magnetic field can be used to simulate the path of an electron in a magnetic field. Some photographs of particular cases are given. A. J. M.

Heavy-carbon production by thermal diffusion. W. W. Watson (*Science*, 1941, **93**, 473—474).—Results achieved in the concn. of ¹³C in CH₄ by a multi-stage thermal diffusion apparatus of the type described previously (A., 1941, I, 68) are recorded. The apparatus is suitable for obtaining a concn. of ¹³C sufficient for tracer-atom work in biological experiments. L. S. T.

Dependence of the secondary electronic emission produced by γ -radiation on the direction of the radiation. C. W. Wilson (*Proc. Physical Soc.*, 1941, **53**, 613—623).—Experiments described show that the electronic emission from a sheet of material, due to γ -radiation, depends on the direction of the radiation with respect to the sheet. In certain directions,

the emission from the sheet is equiv. to that from a sheet of "air-wall" material (graphite). An approx. explanation is given. An examination of the electronic emission from bone irradiated with γ -rays indicates how the energy absorption per röntgen of γ -rays may change at boundaries between bone and soft tissues. N. M. B.

Passage of neutrons through ferromagnets. O. Halpern and T. Holstein (*Physical Rev.*, 1941, [ii], 59, 960—981).—Mathematical. General equations are set up for the behaviour of the neutron spin in different types of magnetic fields which correspond approx. with various stages of magnetisation in ferromagnets, and general results for the depolarisation of an originally polarised beam are obtained. The domain theory of structure is reviewed, and the possibilities of investigating this structure, with reference to single crystals, macroscopically unmagnetised polycrystals, and polycrystals near magnetic saturation, are examined. Formulae for the change of intensity and polarisation of a neutron beam traversing a saturated or quasi-saturated ferromagnetic medium are derived, and form the basis for a modified theory of neutron polarisation experiments. N. M. B.

Passage of neutrons through crystals and polycrystals. O. Halpern, M. Hamermesh, and M. H. Johnson (*Physical Rev.*, 1941, [ii], 59, 981—996; cf. preceding abstract).—Mathematical. The influence of crystal structure on the scattering and polarisation of neutrons is investigated. Scattering formulae are developed which lead to a quant. interpretation of experimental deviations from additivity of nuclear cross-sections. The Larmor precession of the spin of a neutron passing through a magnetised medium and the differentiation between the action of the vectors "B" and "H" are explained as a simple dispersion phenomenon. The formulae permit quant. determination of the transmission and polarisation of neutron beams passing through ferromagnetics. Uncertainties in the evaluation of experiments are discussed. N. M. B.

New radioactive series. (A) W. Wahl. (B) A. C. Lane (*Science*, 1941, 93, 16—17, 17).—(A) Mass spectrograms of geologically-old minerals of the tantalum-Nb group, which contain also some U, Th, and rare-earth metals, show a mass-line 237. This line, which has never before been obtained, must be a member of a new radioactive series of elements. The element may be the parent of the new series, or it may originate from an unknown U isotope. The stable end-product of the new series should be ^{205}Pb or ^{209}Pb . Some of the spectra containing the 237 line show a weak line at 205. (B) A comment on the above. L. S. T.

Scattering of slow neutrons by molecular gases. R. G. Sachs and E. Teller (*Physical Rev.*, 1941, [ii], 60, 18—27).—Mathematical. The cross-section for the scattering of slow neutrons by protons is four times as great for protons strongly bound to an infinite mass as for free protons initially at rest. A simple generalisation of this factor 4 is given for the scattering of neutrons by mol. gases if the neutron energy is \gg the quanta of mol. vibration. In this case the proton may be replaced by a freely moving hypothetical mass point, the mass of which is a tensor depending on the mass and structure of the mol. On this basis the total cross-section for the scattering of slow neutrons by H_2 and by CH_4 , NH_3 , and H_2O at low temp. is calc. as a function of the ratio of the neutron energy to the thermal energy of the scattering gas. The possibility of applying the theory to a determination of the neutron-proton scattering cross-section is discussed. N. M. B.

β -Ray energy of ^3H . S. C. Brown (*Physical Rev.*, 1941, [ii], 59, 954—956).—Using as detector a screen-wall Geiger-Müller counter with He at atm. pressure, the max. range of the ^3H β -rays in He was determined as 13 ± 1 mm., corresponding with a max. energy of 9.5 ± 2.0 ke.v. N. M. B.

Production of radioactive hydrogen by neutron bombardment of boron and nitrogen. R. Cornog and W. F. Libby (*Physical Rev.*, 1941, [ii], 59, 1046).—Saturated solutions containing excess of H_3BO_3 or NH_4NO_3 were bombarded for several thousand $\mu\text{a.}$ -hr. by fast neutrons produced by the $^9\text{Be}(\alpha, n)^{10}\text{B}$ reaction with 16.5-Me.v. deuterons. The H_2O , as vapour in a Geiger-Müller counter, showed an activity of $\sim 10^4$ counts per mole per sec. Possible reactions are discussed. The estimated fast neutron cross-section for the production of ^3H is 10^{-24} sq. cm. N. M. B.

Angular distribution of α -particles produced in the ^7Li -proton reaction. C. L. Critchfield and E. Teller (*Physical Rev.*, 1941, [ii], 60, 10—17; cf. Young, A., 1940, I, 426).—Mathematical. In a discussion of the reaction $^7\text{Li} + ^1\text{H} \rightarrow ^2\text{He}$ it is assumed that the ^7Li nucleus is odd, that the incident proton is in a P state, and that a broad (angular momentum 0) and a sharp (angular momentum $2\hbar$) nuclear resonance level participate in the reaction. Results are in qual. agreement with the observed dependence on energy of the reaction yield and of the angular distribution. N. M. B.

Scattering of 1—3-Me.v. protons by helium. N. P. Heydenburg and N. F. Ramsey (*Physical Rev.*, 1941, [ii], 60, 42—46).—An examination for the existence of resonance scattering analogous to the neutron-He resonance found for 1-Me.v. neutrons by Staub (cf. A., 1939, I, 171) is reported. If n - n and p - p nuclear forces are equal, such a resonance should occur in p -He scattering for protons of ~ 2 Me.v. The no. of protons scattered through 140° , observed as a function of their energy, passed through a max. at 2 Me.v., but the sharpness and height of the max. were several times less than for the n -He resonance. A qual. justification is given. Data for angular distribution of scattered protons for 30— 140° scattering angles and 1—3 Me.v. proton energies are plotted. N. M. B.

New type of disintegration produced by deuterons. R. S. Krishnan and T. E. Banks (*Proc. Camb. Phil. Soc.*, 1941, 37, 317—323).— ^{62}Cu , ^{106}Ag , and ^{120}Sb are formed by the deuteron bombardment of Cu, Ag, and Sb respectively. The energy-yield curves have been determined and indicate that the process involved is $^2\text{H}(\text{H}, \text{H})^{z-1}\text{A}$, probably occurring through the formation of a "compound nucleus" of the Bohr type. The cross-sections for the formation of ^{106}Ag and ^{108}Ag by 9-Me.v. deuterons are 2.5×10^{-29} and 1×10^{-25} cm. 2 , respectively. O. D. S.

Production of characteristic X-rays by deuteron bombardment. J. M. Cork (*Physical Rev.*, 1941, [ii], 59, 957—959). It is shown by a photographic method that for 10-Me.v. deuterons, characteristic K radiation is emitted from targets of at. no. > 38 . Because of absorption, the intensity has a max. for elements of at. no. ~ 28 . L radiation is observed for heavier elements with a max. at at. no. ~ 64 . For a Cu target the yield of X-rays is observed as a function of exciting energy. Results are compared with theory (cf. Henneberg, A., 1933, 881). N. M. B.

Mechanism of deuteron-induced fission. N. Bohr (*Physical Rev.*, 1941, [ii], 59, 1042).—Available data and theoretical considerations are discussed in relation to the discrimination of the two types of processes in deuteron-induced nuclear transformations. N. M. B.

Fission cross-section in uranium and thorium for deuteron impact. J. C. Jacobsen and N. O. Lassen (*Physical Rev.*, 1941, [ii], 59, 1043; cf. A., 1941, I, 144).—The fission cross-section in U at 9 Me.v. deuteron energy, corr. by a calibrating process, is $2.2 \pm 1 \times 10^{-26}$ sq. cm. Hence the U-Th cross-section ratio 0.7 gives $1.5 \pm 0.7 \times 10^{-26}$ sq. cm. for the corresponding Th fission cross-section. N. M. B.

Resonance energy of the thorium capture process. L. Meitner (*Physical Rev.*, 1941, [ii], 60, 58—60; cf. A., 1941, I, 187).—The resonance energy was determined by measuring the absorption in Th for various neutron resonance groups picked out by suitable detectors (Au, In, Rh). Neutron groups having absorption coeffs. with ratio which is not inversely \propto the ratio of the respective velocities indicate a resonance group of the Th capture process within the energy range considered. Results show that for resonance energy $E = 0.9$ e.v. the experimental capture cross-section is \gg , and for $E = 3.5$ e.v. somewhat $<$, that calc. on the $1/v$ law. It is concluded that the Th resonance level is between 0.2 e.v. (cut-off energy of Cd) and 3.5 e.v., and probably at ~ 2 e.v. N. M. B.

Nuclear particles in cosmic radiation. S. A. Korff (*Physical Rev.*, 1941, [ii], 59, 949—954; cf. A., 1941, I, 315).—Balloon-flight experiments with proportional counters show that α -particle counts due to slow-neutron-induced B disintegrations may account for \sim one third of the discharges with BF_3 counters. The estimated flux of highly ionising particles, mostly protons, is $\sim 10^{-3}$ per sq. cm. per sec. The calc. rate of production of protons (about the same as that of neutrons)

is $\sim 5 \times 10^{-2}$ per g. per sec. at 2 m. H_2O equiv. below the top of the atm. Results indicate that protons and neutrons are produced about equally by a process connected with the soft component of the radiation.

N. M. B.

Are there spin one mesotrons? H. Snyder (*Physical Rev.*, 1941, [ii], 59, 1043; cf. Christy, A., 1941, I, 235).—If mesotrons are responsible for nuclear forces, and if they do not have spin $\frac{1}{2}$, then the known spin dependence of nuclear forces demands that, in addition to mesotrons of spin 0, there must be particles of spin 1. There is experimental evidence that mesotrons of spin 0 and 1 are produced. They must be highly absorbable, and a disintegration lifetime of $\sim 10^{-8}$ sec. would not contradict cosmic-ray evidence.

N. M. B.

Secondary slow mesotrons. V. I. Veksler and N. A. Dobrotin (*Physical Rev.*, 1941, [ii], 59, 1044—1045; cf. A., 1941, I, 91).—Measurements with arrangements of counters at 4250 m. confirm the secondary nature of the slow particles (mesotrons) observed (cf. A., 1941, I, 288). Available data are reviewed (cf. Rossi, *ibid.*, 145).

N. M. B.

Extensive cosmic-ray showers and the energy distribution of primary cosmic rays. N. Hilberry (*Physical Rev.*, 1941, [ii], 60, 1—9).—An experimental determination of the variation of the no. of extensive showers per unit time from sea level to 4300 m. is described. The no. of showers expected, calc. on the cascade theory with assumption of various power-law energy distributions for the primary cosmic rays, accords with observation at high altitudes for suitable choice of parameters; at low altitudes the observed excess is what would be expected from a mesotron component in the extensive showers. The choice of parameters giving good agreement with the extensive shower data will also described cosmic-ray observations at much lower energies, and this strongly supports the hypothesis of a single type of primary cosmic-ray particle. The consequences of choosing the proton as this primary particle are discussed.

N. M. B.

Sun's magnetic field and the diurnal and seasonal variations in cosmic-ray intensity. L. Janosy and P. Lockett (*Proc. Roy. Soc.*, 1941, A, 178, 52—60).—The diurnal and seasonal variations in the vertical cosmic-ray intensity due to a solar magnetic dipole are calc. for latitudes 0° and 45° . The diurnal variation at latitude 45° agrees with the existence of a solar dipole of moment 1.1×10^{34} gauss cm^3 , a val. consistent with other evidence. The diurnal variation at the equator cannot be explained by a solar magnetic dipole field. The seasonal variation inferred from the same val. of the dipole moment agrees with observation but shows a phase discrepancy of 2 months.

G. D. P.

Influence of radiation damping on the scattering of light and mesons by free particles. I. W. Heitler (*Proc. Camb. Phil. Soc.*, 1941, 37, 291—300).—Mathematical. Quantum-theory equations for the effect of radiation damping on the scattering of light and mesons are developed. The effect is important for mesons at high energies but is small at low energies.

O. D. S.

Quantum theory of radiation damping. A. H. Wilson (*Proc. Camb. Phil. Soc.*, 1941, 37, 301—316).—A method of calculating the effect of damping on the collision cross-sections for problems involving free electrons and mesons is developed. The final equations are the same as those derived by Heitler (preceding abstract).

O. D. S.

Invariant forms of interaction between nuclear particles. L. Eisenbud and E. P. Wigner (*Proc. Nat. Acad. Sci.*, 1941, 27, 281—289).—It is shown that it is reasonable to expect a wave-equation for heavy particles alone. The possible types of interaction between nuclear particles are investigated assuming the existence of a Hamiltonian for such particles. A non-relativistic approximation is used, and the only interactions considered are those which either do not contain the velocities (or momenta) of the particles, or contain them only to the first power. There are 18 invariant types of interaction between pairs of particles, which are linear in momenta.

A. J. M.

Nuclear radii. R. D. Present (*Physical Rev.*, 1941, [ii], 60, 28—31).—Mathematical. Corrections to the nuclear radius and particle density arising from the neutron excess $N - Z$, from the electrostatic repulsion of the protons, and from the surface tension forces, are calc. on the basis of the statistical model. The density throughout the interior of the heaviest

nuclei is found to be $\sim 30\%$ $<$ in medium light nuclei ($A \sim 50$). The trend of $r_0 = R/A^{1/3}$ from the lightest to the heaviest elements is discussed and compared with experiment.

N. M. B.

Particles with half-integral spin. W. Rarita and J. Schwinger (*Physical Rev.*, 1941, [ii], 60, 61).—Mathematical. An alternative formulation of the theory of Fierz and Pauli (cf. *Proc. Roy. Soc.*, 1939, A, 173, 211) on half-integral spins, avoiding the complicated spinor formalism.

N. M. B.

β -Decay with neutrino of spin $\frac{3}{2}$. S. Kusaka (*Physical Rev.*, 1941, [ii], 60, 61—62; cf. preceding abstract).—Mathematical. An investigation of distribution laws, energy-lifetime relations, and selection rules for β -decay with a neutrino of spin $\frac{3}{2}$ shows that for any coupling involving the neutrino wave function or its first derivative the spectrum distribution is predominantly of the Konopinski-Uhlenbeck type and the energy-lifetime relation for high energy is given by the seventh-power law. For neutrinos of non-zero mass, the Fermi and the Gamow-Teller selection rules are possible; for neutrinos of zero mass only the latter is permitted.

N. M. B.

II.—MOLECULAR STRUCTURE.

Flame spectrum of carbon monoxide. II. Application to "afterburning." A. G. Gaydon (*Proc. Roy. Soc.*, 1941, A, 178, 61—73; cf. A., 1941, I, 97).—The order of magnitude of the radiative lifetime of the vibrationally activated CO_2 mols. formed in the combustion of CO is derived. The results are in agreement with the experimental evidence concerning the effect of moisture and other catalysts on the infra-red emission of the flame. The lifetime is calc. to be about a few tenths of a sec., but dissociation and recombination processes may lengthen this time. The vibrationally active mols. of CO_2 are regarded as essentially normal mols. in which the vibrational energy has not had time to reach equipartition with the energy in other degrees of freedom. Investigation of the absorption spectrum of a long column of burning gas showed strong absorption due to hot O_2 , this being particularly marked when the gases are dry.

G. D. P.

New comet-tail band. R. K. Asundi (*Current Sci.*, 1940, 9, 503—504).—The masking by H_2 of comet-tail bands of CO^+ , produced in a discharge tube containing He and a trace of C, and simultaneous production of triplet C bands of CO can be controlled by suitable use of a Pd tube. Spectrograms of the triplet C bands in the far-red region show a relatively intense band degraded to longer $\lambda\lambda$ and possessing four heads like the comet-tail bands. This is the $3 \rightarrow 3$ band of the comet-tail system, and $\nu\nu$ agree satisfactorily with calc. vals. for the second and fourth heads. The position given by Herzberg (A., 1929, 489) for the system-origin is confirmed.

W. R. A.

Ultra-violet band spectrum of HgBr. M. G. Sastry (*Current Sci.*, 1941, 10, 197; cf. A., 1941, I, 291).—Wieland's class II band system at 2650—2900 \AA . has been re-examined, and is now ascribed to HgBr. A vibrational analysis gives the following consts. for the $^{202}Hg^{81}Br$ heads: ω_e' 459.0, ω_e'' 372.3, $x_e'\omega_e'$ 3.6, $x_e''\omega_e''$ 3.8, ν_e (mol.) 34,537.8 cm^{-1} , ν (at.) 4.92, D' 1.81, D'' 1.15 ν . The quantum no. assignment is confirmed by observations on the $^{202}Hg^{79}Br$ bands. The system is probably due to a $^2\Sigma \rightarrow ^2\Sigma$ transition, with negligible spin doubling; the dissociation products in the two electronic states are $Hg(^1S) + Br(^2P)$ and $Hg(^3P) + Br(^2P)$.

A. J. E. W.

Atmospheric absorption and emission in the infra-red. J. Strong (*J. Franklin Inst.*, 1941, 232, 1—22).—By plotting intensity of radiation against the square root of the no. of air masses, or square root of the amount of H_2O vapour, in the line of sight, a straight line is obtained. By plotting atm. absorption data by this method, as well as by Langley's method (plotting log of radiation intensity against secant of the zenith distance of the sun), it is possible to decide whether the absorption is due to a continuous spectrum or to a band spectrum, since the former gives a linear graph by Langley's method, but not by the new one, and the latter gives a linear graph by the new method.

A. J. M.

Transmission of infra-red light by fog. J. A. Sanderson (*J. Opt. Soc. Amer.*, 1940, 10, 405—409; cf. Hulburt, *Physics*, 1934, 5, 101).—The transmission of clean natural fogs and of a thick snowstorm has been measured at $\lambda\lambda$ 1—12 μ . The

transmission curves, when corr. for the transmission of the clear atm. of approx. the same humidity (measurement taken directly after lifting of the fog), are flat and show no position of max. transmission in this λ region. O. D. S.

Infra-red spectra of polyatomic molecules. II. D. M. Dennison (*Rev. Mod. Physics*, 1940, **12**, 175—214).—The theoretical treatment is briefly reviewed. Ascertained data are collected and discussed for CO_2 , H_2O vapour, NH_3 , Me halides, and CH_4 . W. R. A.

Ultra-violet absorption spectra of nitrogenous heterocyclic compounds. III. Effect of p_{H} and irradiation on the spectrum of 2-chloro-6-aminopyrimidine. (Miss) M. M. Stimson and J. R. Loofbrouw (*J. Amer. Chem. Soc.*, 1941, **63**, 1827—1829).—Two bands, possibly due to dissimilar chromophores, occur between 2200 and 2900 \AA . The $>\text{C}=\text{N}-$ absorption shifts to longer λ as p_{H} rises from 3 to 7, and at higher p_{H} falls off, whilst the extinction of $>\text{C}=\text{N}-$ absorption increases from p_{H} 3 to 10. No apparent decomp. results from irradiation for 4 hr. W. R. A.

Absorption spectra of the phenylpyridines and pyridyl-diphenyls. A. E. Gillam, D. H. Hey, and A. Lambert (*J.C.S.*, 1941, 364—367).—The absorption spectra, between 2200 and 3100 \AA ., of 2-, 3-, and 4-phenylpyridine in EtOH solution, and of 2:2'- and 4:4'-dipyridyl, 3-2', 3-3', and 3-4', 4-2', 4-3', and 4-4'-pyridyldiphenyl in hexane solution have been measured and are represented graphically. The similarity of these spectra with those of di- and ter-phenyl (A., 1939, I, 449) indicates that the bond linking a $\text{C}_5\text{H}_4\text{N}$ to a C_6H_5 nucleus is similar in its resonance characteristics to that between two C_6H_5 nuclei. O. D. S.

Ultra-violet absorption spectrum of papain.—See A., 1941, III, 796.

Sensitized fluorescence (chemifluorescence) of benzene. H. A. Gordon (*Acta Physicochim. U.R.S.S.*, 1940, **13**, 393—398).—When previously irradiated 1% glycine solution is evaporated to dryness and the residue shaken with H_2O and C_6H_6 the fluorescence bands of C_6H_6 in the region 2500—3000 \AA . are emitted, together with a band in the region 2420—2460 \AA . There is a definite induction period for the fluorescence, which is independent of the concn. of irradiated glycine or of C_6H_6 but varies from 3 min. at 3° to 45 sec. at 40°. J. W. S.

Fluorescence of coumarin derivatives.—See A., 1941, II, 301.

Chemiluminescence of luminol catalysed by iron complex salts of chlorophyll derivatives.—See A., 1941, II, 271.

Optical methods for study of molecular structure: Raman spectra method. G. M. Murphy (*J. Opt. Soc. Amer.*, 1940, **10**, 396—404).—A review. The methods of investigation of mol. structure by the Raman spectra, and results for simple gases, are discussed. O. D. S.

Optical sensitisation and photovoltaic effect of dyes. B. S. V. R. Rao (*Current Sci.*, 1941, **10**, 198—199).—With erythrosin, chrysoidin, methylene-blue, and Me- and mala-chite-green the spectral regions for max. sensitisation and max. photo-potential correspond closely, and lie at slightly higher λ than the absorption max. The photovoltaic and sensitisation effects are probably secondary phenomena arising from impact of dye mols., activated by light absorption, with the electrode or sensitised emulsion. Sensitisation and desensitisation are probably a single phenomenon, the sensitiser acting on one or both of two opposed processes. A. J. E. W.

Electrical conduction and related phenomena in solid dielectrics. M. F. Manning and M. E. Bell (*Rev. Mod. Physics*, 1940, **12**, 215—256).—A review in which are treated experimental methods, the methods for distinguishing between electronic and ionic conduction, ionic conductivity, dielectrics in alternating fields, lattice defects, semi-conductors, colour centres and photoconductivity, breakdown, and quantum-mechanical ideas of conduction. W. R. A.

Dielectric properties of the rutile form of TiO_2 . L. J. Berberich and M. E. Bell (*J. Appl. Physics*, 1940, **11**, 681—692).—The dielectric const. (ϵ) and power factor at 60—10⁶ cycles and 30—125° have been measured for three specimens of rutile prepared by compressing powdered material with and without ceramic admixture and firing at 1330—1675°.

ϵ is approx. const. at ~ 100 throughout the frequency range studied, with an average temp. coeff. of -8.2×10^{-4} per ° c. In the infra-red region it falls off. The power factor decreases with increasing frequency to 0.0005 at 10⁶ cycles. ϵ for mixtures of rutile with other dielectrics follows a logarithmic mixture formula. The high val. of ϵ is explained by a mechanism based on the Clausius—Mosotti equation. L. J. J.

Dipole moment and bond character in organometallic compounds.—See A., 1941, II, 245.

Molecular volume of saturated hydrocarbons. S. S. Kurtz, jun., and M. R. Lipkin (*Ind. Eng. Chem.*, 1941, **33**, 779—786).—The mol. vol. (V) of saturated hydrocarbons can be represented by $V = 16.28n_1 + 13.15n_2 + 9.7n_3 + 31.2$, where n_1 , n_2 , and n_3 are the nos. of chain, ring, and ring-junction C atoms, respectively. The relation is used to calculate d -at. wt. curves for paraffins and various classes of naphthenes. It is suggested that the difference in d between naphthenes of equal mol. wt. and equal nos. of rings per mol. can be used to calculate the average no. of C atoms per ring. The relation also indicates that Staudinger's hydrocyclorubber contains 60—62% of ring CH_2 groups and 38—40% of chain CH_2 groups. J. W. S.

Critical temperature from index of refraction. S. W. Wan (*J. Physical Chem.*, 1941, **45**, 903—907).—The expression $T_c = k_1R + k_2$ has been deduced as a linear relation between crit. temp. (T_c) and mol. refraction (R). Data for six types of aliphatic compounds have been used to test the expression, and vals. of k_1 and k_2 for each type of compound have been evaluated. The agreement between observed and calc. T_c vals. is good. C. R. H.

Rotatory powers of camphoranilic acids, α - and β -naphthylcamphoramidic acids.—See A., 1941, II, 299.

Magneto-optic rotation. III. Carbon disulphide in substituted benzenes. C. E. Waring, H. H. Hyman, and S. Steingiser (*J. Amer. Chem. Soc.*, 1941, **63**, 1985—1988; cf. A., 1940, I, 403).—Verdet consts., ρ , and n for solutions of CS_2 in PhMe, PhCl, PhBr, PhNO₂, and cyclohexane have been measured at 25°. A resonance structure is postulated for liquid CS_2 . W. R. A.

Lifetime of activated triatomic molecules and the mechanism of predissociation of nitrosyl chloride. G. L. Natanson (*Acta Physicochim. U.R.S.S.*, 1940, **13**, 317—326).—Rosen's formula (A., 1934, 7) for the probability of transition of vibrational energy between the bonds of a linear triat. mol., leading to the dissociation of one of them, is extended to include complex transitions through intermediate quantum states, which shorten considerably the lifetime of an activated mol. to the moment of its dissociation. The theory is applied to the NOCl mol., and it is shown that the interpretation of its predissociation as a vibrational predissociation avoids the assumption of an unknown very low excited level of the NO mol. (A., 1939, I, 550). J. W. S.

Hydrogen bond. R. M. Barrer (*J. Soc. Dyers and Col.*, 1941, **57**, 264—268).—H-bonds are of various strengths characterised by differing distances between the bonded atoms, e.g., (i) OH bonds (Bernal *et al.*, A., 1935, 1307); (ii) those of intermediate strength as in the fatty acid dimers; (iii) extremely strong as in $\text{H}_2\text{C}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$ or KH_2PO_4 . The bonding power of H is not primarily due to co-ordinate linkings being formed; it increases in the order (for ions) $\text{Cl} < \text{N} < \text{O} < \text{F}$, i.e., increasing order of electron affinity. The additional stability and shorter distances between the bonded atoms in (iii) are ascribed to resonance. The possibility of H-bonds in proteins is discussed. H. B.

Investigation by electron diffraction of the structures of tetrahalides. M. W. Lister and L. E. Sutton (*Trans. Faraday Soc.*, 1941, **37**, 393—406; cf. A., 1939, I, 307).—Data are recorded for CBr_4 , Cl_4 , SiBr_4 , SiI_4 , GeBr_4 , GeI_4 , SnBr_4 , SnI_4 , PbCl_4 , TiCl_4 , ZrCl_4 , ThCl_4 , and SeCl_4 . In all compounds in which the configuration would significantly affect the mode of scattering the assumption of a tetrahedral mol. is satisfactory. Bond lengths are tabulated; they are mostly < the sum of the covalent at. radii. F. L. U.

Covalency, ionisation, and resonance in carbon bonds. E. C. Baughan, M. G. Evans, and M. Polanyi (*Trans. Faraday Soc.*, 1941, **37**, 377—393).—The properties and electrolytic dissociation of bonds between (a) Me and (b) H, halogen, and

Na are discussed in terms of the potential energy curves of the ground and ionic states of these bonds and their resulting ionic resonance energy. By considering also the additional resonance of alkyl radicals between several canonical forms the observed bond strengths and dipole moments of some alkyl compounds are explained. Applications of the theory to the proton affinity of C_2H_4 , the solvolysis of alkyl halides, and the reaction of Na with hydrocarbons are also discussed.

F. L. U.

Resonance energies of unsaturated and aromatic molecules. G. W. Wheland (*J. Amer. Chem. Soc.*, 1941, **63**, 2025—2027).—A simplification of the method of Mulliken and Rieke (*ibid.*, 1770) is developed and applied to unsaturated mols. and free radicals. The inclusion of the non-orthogonality integral, S , in the mol. orbital treatment makes no appreciable difference in the self-consistency of calculation of resonance energies of the mols. or free radicals considered.

W. R. A.

Structure of alicyclic compounds. V. G. Aston, S. C. Schumann, H. L. Fink, and P. M. Doty (*J. Amer. Chem. Soc.*, 1941, **63**, 2029—2030).—The entropy of cyclopentane has been calc. at various temp. for the symmetry structures, D_{5h} , C_5 , and C_5 . The calorimetric val. agrees best with the calc. val. for the non-planar configuration C_5 , symmetry no., σ , = 1. A similar result is found for methylcyclopentane. *cyclohexane* has $\sigma = 6$.

W. R. A.

Structure of vinyl co-polymerides. F. T. Wall (*J. Amer. Chem. Soc.*, 1941, **63**, 1862—1866).—The structure of co-polymerides is considered theoretically and it is concluded that an ordinary co-polymeride consists of a mixture of polymerides subject to a composition distribution function. A "true co-polymeride" is defined as consisting of individual chains of the same composition (within reasonable statistical fluctuations) as the mass of the polymeride. The experimental conditions governing the formation of a "true co-polymeride" are briefly discussed. The intramol. distribution of monomer units within polymeride chains is considered. Preliminary experimental results on co-polymerides of vinyl chloride and acetate are in accord with theory as to both rates of polymerisation and removal of Cl by Zn.

W. R. A.

Complex formation. N. V. Sidgwick (*J.C.S.*, 1941, 433—443).—Liversidge lecture. The structures of co-ordination compounds are discussed with reference to the electronic properties of the acceptor and donor mols.

O. D. S.

Constants of the Beattie-Bridgman equation. J. Corner (*Trans. Faraday Soc.*, 1941, **37**, 358—361).—The third virial coeffs. calc. by de Boer and Michels (cf. A., 1939, I, 248) can be used to interpret the consts. a and b of the Beattie-Bridgman equation.

F. L. U.

Measurement of contact angles. A. Ferguson (*Proc. Physical Soc.*, 1941, **53**, 554—568).—A lecture. The problem is examined mathematically, and available experimental methods are discussed.

N. M. B.

III.—CRYSTAL STRUCTURE.

Optical methods for study of molecular structure: X-ray method. B. E. Warren (*J. Opt. Soc. Amer.*, 1940, **10**, 369—373).—A review of X-ray diffraction methods and results in the study of mol. structure in the gaseous, liquid, and, in particular, the cryst. state.

O. D. S.

Classical and quantum reflexions of X-rays. (Sir) C. V. Raman and P. Nilakantan (*Physical Rev.*, 1941, [ii], **60**, 63—64).—Various considerations refute the suggestion that the modified or quantum reflexion (cf. A., 1940, I, 348) may be explained as "diffuse maxima in the scattering of X-rays by elastic waves of thermal origin" (cf. Zachariasen, A., 1941, I, 324; Siegel, *ibid.*, 195; Jahn, *ibid.*, 102).

N. M. B.

Accurate evaluation of lattice spacings from back-reflexion powder photographs. S. S. Lu and Y. L. Chang (*Proc. Physical Soc.*, 1941, **53**, 517—528).—Methods have been devised for the correction of all systematic errors. For cubic crystals, the observed lattice spacings plotted against $\cos \phi$, where ϕ is the supplement of the angle of deviation, give a straight line. The extrapolation to $\cos \phi = 1$ gives the corr. lattice const. Non-cubic crystals require an analytical method. The systematic errors will make $\cos^2(\phi/2)$ inaccurate by an amount $\propto \sin^2 \phi$, which may thus be introduced as a correction term to the Bragg equation in the quadratic

form. Determinations, accurate to ~ 1 in 50,000, of the lattice spacings of very pure Al, α -Fe, Ni, Cu, Mo, W, Pb, Cd, and Sb are given.

N. M. B.

Secondary diffraction effect on Laue photographs of diamond. K. Lonsdale and H. Smith (*Proc. Physical Soc.*, 1941, **53**, 529—531).—With normal apparatus and X-rays from a Cu or Fe target, well-exposed Laue photographs of diamond sometimes show sharp diffraction curves around (111), (220), or (113) Laue spots. These curves are due to secondary diffraction by the black paper (light-tight) cover of the film-holder, and occur only when the crystal is correctly set, to within $\pm 0.3^\circ$, for selective reflexion of the characteristic $K\alpha$ or β radiation from one of these strongly reflecting diamond planes. The effect is a useful indication of correct crystal setting for monochromatisation, and provides a measure of the width of the monochromatised beam, but may introduce error in intensity measurements, especially with long- λ radiation.

N. M. B.

Structure and molecular anisotropy of sorbic acid, $CHMe:CH:CH:CH:CO_2H$. K. Lonsdale, J. M. Robertson, and I. Woodward (*Proc. Roy. Soc.*, 1941, **A**, **178**, 43—52).—The monoclinic unit cell contains eight mols. linked in pairs by H bonds about the symmetry centres of the crystal; the long chain axis of the mol. lies near the (010) plane and is inclined at between 10° and 15° to the a axis. The mol. chains are turned about their axes so as to bring some of the atoms out of the (010) plane. The magnetic and optical anisotropies provide an approx. measure of this rotation. The orientation of the mols. has been confirmed by observation of the size and shape of the diffuse spots recorded on well-exposed Laue photographs taken with a Cu target. The usefulness of these spots as a secondary method of structure determination is emphasised.

G. D. P.

Bond lengths and resonance in the *cis*-azobenzene molecule G. C. Hampson and J. M. Robertson (*J.C.S.*, 1941, 409—413; cf. Robertson, A., 1939, I, 186).—A determination of the structure of the *cis*-azobenzene mol. has been carried out by the Fourier analysis of the X-ray diagram of the cryst. substance. The mol. is not coplanar, the two Ph rings being rotated so that the distance between the o and o' C atoms is 3.34 Å. Differences in the lengths of the N—N and C—N bonds from those observed in the *trans*-azobenzene mol. (*ibid.*) indicate that resonance with the C:N double bond structure is suppressed in the *cis*-compound owing to steric hindrance. Distortion of the valency angles is also observed.

O. D. S.

X-Ray analysis of protein denaturation.—See A., 1941, II, 306.

Proteins.—See A., 1941, II, 113, 114, 306.

Optical methods for study of molecular structure: electronic diffraction method. L. R. Maxwell (*J. Opt. Soc. Amer.*, 1940, **10**, 374—395).—A review of the methods and results of electron diffraction investigation of mol. structure in the gaseous state. Data for mol. structures, as published up to 1940, are tabulated.

O. D. S.

Investigation by electron diffraction of dihalides of cadmium, tin, and lead. M. W. Lister and L. E. Sutton (*Trans. Faraday Soc.*, 1941, **37**, 406—419).—Examination of electron diffraction patterns of vapours of the dihalides (excluding fluorides) of Cd, Sn, and Pb indicates that the valency angle in the Cd compounds is probably 180° , and is $< 180^\circ$ in the Sn and Pb compounds. Bond lengths are calc. The Cd-halogen bond lengths are $<$ the sums of the appropriate covalent radii, but no contraction is observed for the Sn and Pb compounds; this is interpreted as meaning that the covalencies in Sn^{II} and Pb^{II} compounds involve only p -orbitals on the metal atom.

F. L. U.

Geometrical crystallography of PbO_2 and Pb_5O_8 . H. R. Davidson (*Amer. Min.*, 1941, **26**, 18—24).—Large crystals of PbO_2 and Pb_5O_8 have been obtained by heating PbO_2 , NaOH, and H_2O for 4—6 days at 260—390° in a Au-lined steel bomb. At higher temp., some yellow flakes of PbO are formed. Both the PbO_2 (c 0.6785) and the Pb_5O_8 (c 0.989) are tetragonal. The crystallographic forms obtained are described.

L. S. T.

Crystal structure of coumarin. S. R. Swamy (*Current Sci.*, 1941, **10**, 197—198).—Coumarin has a 15.44, b 7.92, c 5.66 Å., space-group C_{2v}^2 . The c -axis is normal to the optic axial

plane, and the crystal is positive with the acute bisectrix parallel to the b -axis. Diamagnetic anisotropy vals. $[(\chi_p - \chi_g)_M]$ [P. Nilakantan] are: $pg = ac, 31.8$; $ab, 109$; $cb, 79.0 \times 10^{-6}$, i.e., $\chi_b > \chi_c > \chi_a$. It is concluded that the plane of the mol. is parallel to the ac plane, with the longest dimension approx. parallel to the a -axis. A. J. E. W.

New technique for preparing monocrystalline metal surfaces for work function study. Work function of Ag (100). P. A. Anderson (*Physical Rev.*, 1941, [ii], 59, 1034—1041; cf. A., 1940, I, 147).—The structural dependence of the work functions was studied by a method depending on the formation of metallic films, which are in effect single crystals with a (100) plane parallel to NaCl (100), when cubic lattice metals are condensed on heated cleavages of rock-salt. A Ag-rock-salt film was prepared in the measuring tube and its contact p.d. determined against polycryst. Ag films on glass at room temp. and against a reference metal (Ba) of known work function. The contact p.d. vals. are Ag (rock-salt)—Ag (glass), $\sim 0.32 \pm 0.03$ and Ag (glass)—Ba, 1.95 v.; the corresponding calc. work functions are Ag (glass) 4.47 and Ag (rock-salt) 4.79 e.v., the latter being tentatively identified with the work function of Ag (100). N. M. B.

Magnetostriction, Young's modulus, and damping of 68 Permalloy as dependent on magnetisation and heat-treatment. H. J. Williams, R. M. Bozorth, and H. Christensen (*Physical Rev.*, 1940, [ii], 59, 1005—1012).—Magnetostriction varied with heat-treatment from 2.5×10^{-6} to 22×10^{-6} . The variation in change of Young's modulus, E , with magnetisation to saturation was 0.09—10.5%. The damping of mechanical vibrations was measured as dependent on magnetisation and heat-treatment. E and the damping const. were determined by measuring the natural frequency of vibration and the width of the resonance curve of a hollow rectangle magnetised parallel to its sides. Results are considered in relation to the domain theory. N. M. B.

Contact electrification of solid particles. R. Schnurmann (*Proc. Physical Soc.*, 1941, 53, 547—553).—The sign of the acquired charge was determined for metal particles poured from SiO₂ or glass containers, and for particles of various dielectrics poured from SiO₂, glass, or metal containers. The particles convey their charge to a closed insulated funnel; when this charge is removed and the particles stream from the funnel, the latter again acquires a certain charge and the particles carry the opposite charge to the receptacle. Some acquired charges are: Cu filings (+) from a glass or SiO₂ container; SiO₂ (−) from a Cu trough; bulk SiO₂ (+) when rubbed against bulk Cu; Sb powder (−) from a glass or SiO₂ container; glass or SiO₂ (+) when rubbed against bulk Sb. Explanations are discussed. N. M. B.

Stress-strain curve for the atomic lattice of iron. S. L. Smith and W. A. Wood (*Proc. Roy. Soc.*, 1941, A, 178, 93—106).—The stress-strain relation for Fe of 99.95% purity was measured by an extensometer and the changes in lattice parameter were simultaneously recorded. Up to the yield point the lattice contraction, measured in a direction perpendicular to the applied stress, \propto the stress. Beyond the yield point the contraction slows down and a tendency to expansion sets in before fracture. In a further set of experiments the test-piece was subjected to a cycle of stress and it was found that on the removal of stresses exceeding the yield stress a permanent lattice expansion exists in the metal. The bearing of these results on the internal strains in the metal is discussed. It is shown that the residual expansion in the lattice after stresses $>$ the yield stress is removed by short heat-treatment at 300°, considerably below the recrystallisation temp. of the metal. G. D. P.

IV.—PHYSICAL PROPERTIES OF PURE SUBSTANCES.

Superconducting films as radiometric receivers. D. H. Andrews, W. F. Brucksch, jun., W. T. Ziegler, and E. R. Blanchard (*Physical Rev.*, 1941, [ii], 59, 1045—1046; cf. Goetz, A., 1939, I, 490).—Preliminary results obtained with Pb films evaporated on glass are reported. N. M. B.

Magnetic susceptibilities of halides. G. Farid (*Current Sci.*, 1940, 9, 492—493).—Vals. of χ ($\times 10^6$) are given for SbOCl, 1—2.30; ("C trichlorate" —2.44; Pr₂Cl₆ + H₂O +0.18; C₆H₁₁NCl —5.27; (CH₂.NH₂)₂.HCl —0.79; aq. Cr₂Cl₆ +3.98;

FeCl₂ + H₂O +55.56; CrCl₂ +30.91; TaCl₅ +0.39; ThCl₄ + 8H₂O —0.34. W. R. A.

Determination of the vapour pressure curve of liquid helium below 1.6° K. using a magnetic thermometer. B. Bleaney and R. A. Hull (*Proc. Roy. Soc.*, 1941, A, 178, 74—85).—The determination was carried out using the susceptibility of Mn NH₄ sulphate and of K Cr alum as the thermometer. The results agree with the theoretical curve within 0.004° down to 1° K. but differ from previous experimental work. G. D. P.

Effective susceptibility of a paramagnetic powder. B. Bleaney and R. A. Hull (*Proc. Roy. Soc.*, 1941, A, 178, 86—92).—The effective susceptibility of a paramagnetic powder loosely packed into an ellipsoidal container was measured against the v.p. of liquid He and hence against the susceptibility of the compact salt (cf. preceding abstract). The results show that the theoretical expression for the demagnetising field derived for certain special forms of space lattice can be used in the general case of a powder formed by crushing salt crystals. G. D. P.

Composition of Prussian and Turnbull's blues. VI. Magnetic susceptibility. A. K. Bhattacharya (*J. Indian Chem. Soc.*, 1941, 18, 85—88; cf. A., 1941, I, 385).—The magnetic susceptibilities (χ) of Prussian blue (I) and Turnbull's blue (II) are ~ 19.5 and ~ 21 Weiss magnetons per g.-atom of Fe, respectively, whereas the calc. vals. are 16.5 and 19.6 Weiss magnetons, respectively. Samples of (I) and (II) aged in contact with their mother-liquors tend to attain equal χ , indicating their tendency to become identical in composition. Slight variations of χ with changing concns. of the solutions used in pptn. are attributed to the effects of adsorption on the compositions of the compounds. J. W. S.

Sound velocities in gases under different pressures. R. C. Colwell and L. H. Gibson (*J. Acoust. Soc. Amer.*, 1941, 12, 436—437).—The velocity of sound in gases can be measured over short distances by producing sound pulses in the gas with a loud speaker, picking them up with a microphone, and passing them into an oscilloscope. The apparatus was used with air, N₂, and CO₂, the measured velocities being 331.42, 337.12, and 258.57 m. per sec., respectively, and independent of pressure. A. J. M.

Ultrasonic absorption and velocity measurements in numerical liquids. G. W. Willard (*J. Acoust. Soc. Amer.*, 1941, 12, 438—448).—The velocity and absorption of ultrasonic waves in about 40 org. liquids, mixtures of liquids, solutions of solids, and a gel were determined over the frequency range 6—30 megacycles by the diffraction method. In general, the velocity is independent of frequency, and the absorption \propto (frequency)², and is not connected with viscous and thermal losses. Absorption errors due to sound diffraction and spreading are considered, and a simple method of estimating them is proposed. A. J. M.

Absorption of sound in CO₂, N₂O, COS, and CS₂, containing added impurities. V. O. Knudsen and E. Fricke (*J. Acoust. Soc. Amer.*, 1941, 12, 449).—A correction (cf. A., 1941, I, 34). A. J. M.

Optical reflexion factors of acoustical materials. P. Moon (*J. Opt. Soc. Amer.*, 1941, 31, 317—324).—Reflexion factors and trichromatic coeffs. are given for 100 samples of acoustical materials and insulating boards. L. J. J.

Thin evaporated silver films on glass. J. Strong and B. Dibble (*J. Opt. Soc. Amer.*, 1940, 30, 431—438).—Measurements of the reflectivity and transmittivity of evaporated Ag films on glass for bands with centres at 6150, 5400, and 4650 Å. show that films fall into two well-defined classes. α -Films, mainly of high density $> 4 \mu\text{g}$. Ag per sq. cm., have high efficiencies, appear blue by transmitted light, and show no scattering. As the density of the films is increased their properties vary continuously towards those of massive Ag. β -Films, mainly of density $< 10 \mu\text{g}$. Ag per sq. cm., show low efficiencies, vary in colour from reddish-yellow to blue with increasing density, and show scattering. The properties of ultra-penumbral deposits formed at the back of the collecting plate during evaporation are similar to those of β -films and the characteristic β -film properties can be observed to higher densities than in directly evaporated films. Published data for the optical properties of sputtered films (Goos, A., 1936, 769) are found to be similar to the β -type for densities

<25 $\mu\text{g.}$ per sq. cm. and to the α -type for densities >30 $\mu\text{g.}$ per sq. cm. The structure of β -films is discussed.

O. D. S.
Specific heat of the sodium chloride crystal. E. W. Kellerman (*Proc. Roy. Soc.*, 1941, **A**, 178, 17—24).—The sp. heat of NaCl is calc. from a determination of some 280 proper frequencies of the crystal lattice. Good agreement with experiment is obtained; the errors in Debye's theory are shown to arise from the assumption of ν^2 law for the frequency distribution.

G. D. P.
Heat capacities and entropies of aluminium and copper from 15° to 300° K. W. F. Giauque and P. F. Meads (*J. Amer. Chem. Soc.*, 1941, **63**, 1897—1901).—Vals. of C_p for single crystals of Al and Cu have been measured from 15° to 300° K.; they are slightly > those for harder forms produced by cold-working. The entropies at 25° are 6.77 g.-cal. per degree per g.-atom for Al and 7.97 for Cu but these vals. do not include the entropy due to nuclear spin and isotopic mixtures. Free energy and heat content vals. from 15° to 300° K. are given for both.

W. R. A.
Heat capacities and entropies of silver and lead from 15° to 300° K. P. F. Meads, W. R. Forsythe, and W. F. Giauque (*J. Amer. Chem. Soc.*, 1941, **63**, 1902—1905).—The heat capacities of single crystals of Ag and Pb have been measured from 15° to 300° K. and thermodynamic properties have been derived. The entropies at 298.1° K. are 10.21 g.-cal. per degree per mol. for Ag and 15.51 for Pb. C_p vals. for Al, Cu (see preceding abstract), Ag, and Pb are compared by the Debye equation.

W. R. A.
Heat capacities of organic vapours. C. J. Dobratz (*Ind. Eng. Chem.*, 1941, **33**, 759—762).—The method of calculating heat capacities of org. vapours from valency bond frequencies (A., 1938, I, 303) has been extended by including rotation within the mol. Frequencies have been assigned to linkings involving halogens, N, and S; these, combined with vals. assigned previously to linkings involving C, H, and O atoms, permit the calculation of the heat capacities of the vapours of most org. compounds with an accuracy of $\pm 5\%$.

J. W. S.
M.p. of tellurium. F. C. Kracek (*J. Amer. Chem. Soc.*, 1941, **63**, 1989—1990).—Electrolytic Te, purified by vac. distillation in Pyrex at $\sim 575^\circ$, has m.p. $449.8 \pm 0.2^\circ$.

W. R. A.
Calculation of b.p. of aromatic hydrocarbons. C. R. Kinney (*Ind. Eng. Chem.*, 1941, **33**, 791—794; cf. A., 1939, I, 134; 1940, I, 16, 247).—The method of calculating b.p. from mol. structure has been extended to aromatic hydrocarbons. By taking the b.p. no. (B.P.N.) of C_6H_6 as 20, and suitable vals. for substituent groups, dependent on their relative positions, the method can be applied to the calculation of the b.p. of C_6H_6 , Ph_2 , and $C_6H_4Ph_2$ compounds. The method also permits the setting of certain limitations on the structure of a hydrocarbon if its b.p. and mol. formula are known.

J. W. S.
Second virial coefficient of acetaldehyde. E. A. Alexander and J. D. Lambert (*Trans. Faraday Soc.*, 1941, **37**, 421—426).—The second virial coeff. (B) of MeCHO has been obtained from $PV-P$ measurements at a series of temp. between 15° and 300°. Comparison with vals. of B calc. from crit. data shows a large discrepancy at lower temp. This is not due to adsorption, but is accounted for by assuming polymerisation with a heat of 5226 g.-cal. per mol.

F. L. U.
Theory of the liquid state. I. Statistical treatment of the thermodynamics of liquids by the theory of holes. II. Application of the hole theory to superheated liquids and supersaturated solutions of gases in liquids. III. Hole theory of the viscous flow of liquids. R. Fürth (*Proc. Camb. Phil. Soc.*, 1941, **37**, 252—275, 276—280, 281—290; cf. A., 1941, I, 106).—I. The previously developed theory of the liquid state is developed by classical statistical mechanics. The mean size v_m at the triple point of the "holes" is calc. for a no. of metals to be $\gg v_a$, the at. vol. of the metals. For some non-metals and chemical compounds v_m is of the same order as v_a . The compressibility κ of a liquid is expressed as the sum of the compressibility κ^* of the "holes" in the liquid and a factor representing the κ of that part of the liquid which is in a state approximating to the cryst. In accordance with this view the calc. val. of κ^* at the triple point is in general < the experimental val. of κ at the m.p. A similar expression for the coeff. of thermal expansion agrees with

the experimental val. An expression for the ratio of the sp. heats c_p/c_v is derived and agrees with experiment. It is deduced that the sp. heat of a metal should increase by ~ 1 g.-cal. per mol. on fusion and this is in fair agreement with experiment.

II. A case of metastable equilibrium in the growth of small "holes," described in Part I, is identified with the superheated state of liquids and supersaturated solutions of gases in liquids. The main properties of the supersaturated state are accounted for.

III. Expressions for the abs. val. of the viscosity of a liquid and its dependence on temp. are deduced, and agree with experiment.

O. D. S.
Helium the superfluid. K. K. Darrow (*Rev. Mod. Physics*, 1940, **12**, 257—266).—A lecture.

W. R. A.
Liquid He II. H. Hsü and W. Band (*Physical Rev.*, 1941, [ii], **59**, 1013—1018).—Mathematical. A treatment of the equilibrium between the two competing sets of states of atoms in a two-dimensional surface monolayer and the normal three-dimensional body of the liquid, with reference to Einstein-Bose statistics and the Einstein λ -point. The theory explains the thermomechanical or "fountain" effect and suggests an interpretation of the surface transfer phenomena.

N. M. B.
Supercooled silicates and their importance in considerations of the liquid state. E. Preston (*Proc. Physical Soc.*, 1941, **53**, 568—584).—A study of crystallisation, viscosity, electrical conductivity, and surface tension shows that silicate glasses are supercooled liquids and may be regarded as solutions, the constituents of which are associated to a degree depending on composition and temp. Recent researches on the structure of glasses by X-ray methods indicate that it is typical of the liquid state. Glass at room temp. has a static structure as opposed to the dynamic configuration of the particles of a normal liquid, and hence simple glasses may assist the elucidation and provision of an adequate theory of the structure of liquids.

N. M. B.
Temperature coefficient of static friction. R. Schnurmamm (*Proc. Physical Soc.*, 1941, **53**, 538—546).—Angles of repose of metals were measured under controlled vac. conditions for steel, Cu, Al, and Cd sliding rods on similar crutches and on naked metal (Al and Cd) surfaces obtained by cleaning by volatilisation in high vac., and on Al volatilised on steel. Experiments on Cd at 176° to -100° in a baked-out friction chamber show a general drift with temp. and are an approach to the thermodynamical criterion for the fundamental mechanism of friction between naked metal surfaces. Analysis of measurements between -100° and 100° leads to a temp. coeff. $(-3.5 \text{ to } 8) \times 10^{-2}$ degrees of the angle of repose. Above $\sim 100^\circ$ the angle of repose of naked Cd increases with rising temp.

V.—SOLUTIONS AND MIXTURES (INCLUDING COLLOIDS).

Thermal conductivity of binary systems: air-sulphur dioxide, air-diethyl ether, and air-benzene. F. Ishikawa and J. Abe (*Bull. Inst. Phys. Chem. Res. Japan*, 1941, **20**, 292—300).—The thermal conductivity of the binary mixtures was measured at 25° under various total pressures. The conductivity curves are convex to the composition axis except for the air- C_6H_6 mixture at 300 mm., which is linear. SO_2 and org. vapours in air may be determined with an accuracy of 0.15% by the thermal conductivity method.

W. R. A.
Thermal diffusion coefficient for isotopes. II. R. C. Jones (*Physical Rev.*, 1941, [ii], **59**, 1019—1033; cf. A., 1940, I, 389).—Mathematical. A general treatment of the 9,5 Lennard-Jones model of intermol. forces indicates that the thermal diffusion const. first increases slightly with fall of temp., then decreases rapidly, passing through zero and becoming negative at ~ 1.5 times the crit. temp.; it then becomes strongly negative with further fall of temp., and approaches zero as the temp. approaches 0° K. Results are discussed with reference to available experimental data.

N. M. B.
i ξ - and *s* ξ -nomograms for the system benzene-water vapour. S. V. Balian (*J. Appl. Chem. Russ.*, 1940, **13**, 1612—1619).—Nomograms are given, with examples of their use.

R. T. 55

Heat capacity and density of aqueous solutions of potassium iodate, potassium hydrogen sulphate, iodic acid, and sulphuric acid at 25°. M. Randall and M. D. Taylor (*J. Physical Chem.*, 1941, **45**, 959—967).—Heat capacities at 25° of aq. solutions of HIO_3 , KIO_3 , KHSO_4 , and H_2SO_4 have been determined, and the partial mol. heat capacities (\bar{c}_p) of the constituents of the solutions have been calc. When \bar{c}_p is plotted against $m^{0.5}$ (m = molarity) the curves are very steep as m approaches 0. This behaviour can be explained by assuming that HIO_3 and HSO_4^- are weak acids; a similar explanation seems applicable to data for AcOH and citric acid. C. R. H.

Cryoscopic investigation of some halides of lithium, rubidium, and caesium in a nitrobenzene solution of aluminium bromide. J. F. Meshenni (*Ber. Inst. Chem. Ukrain. Akad. Wiss.*, 1940, **7**, 363—373).—F.p. of PhNO_2 solutions containing 0 to 1 mol. of LiCl , RbCl , CsCl , or RbI to 1 mol. of AlBr_3 in 15—25 mols. of PhNO_2 were determined. All the halides used appear to have the normal mol. wt.; this behaviour is presumably due to formation of a compound $\text{M}[\text{AlBr}_3\text{Cl}]$ and its complete dissociation into M^+ and $[\text{AlBr}_3\text{Cl}]^-$. J. J. B.

Persistence of fine structure of faces of growing sodium chloride crystals. I. Deposition of solid and supersaturation at different stages of growth of sodium chloride crystals. G. Nitschmann. II. Morphological development of faces of growing sodium chloride crystals of type I with high supersaturation. K. Spangenberg and G. Nitschmann (*Z. Krist.*, 1940, **102**, 285—308, 309—344; cf. A., 1939, I, 129; Nitschmann, *Diss.*, Breslau, 1939).—I. A further detailed study of the influence of supersaturation and other factors on the mode and rate of growth of NaCl crystals from aq. solutions. Under specified conditions growth does not occur from a slightly supersaturated solution, a region of "ineffective supersaturation" existing just above the saturation point.

II. The fine structure of faces in course of development is studied by goniometric measurements and "reflectograms," and the mechanism of growth and the effect of supersaturation are further considered. A. J. E. W.

Ineffective supersaturation region and alleged dependence of saturation concentration on crystal structure of the solid phase. K. Spangenberg (*Z. Krist.*, 1940, **102**, 345—348).—The work of Balarev and Kolarov (A., 1941, I, 206) is discussed in relation to the results reported in the preceding abstract. A. J. E. W.

Crystallisation of ammonium chloride and bromide from aqueous solution, in presence of various cations. J. J. Tilman (*J. Gen. Chem. Russ.*, 1940, **10**, 1631—1640).—The habit of NH_4Cl and NH_4Br crystals separating from aq. solutions of these salts changes from dendrites to cubes, through a series of intermediate forms, as the concn. of chlorides of various other metals rises. The effectiveness of various cations falls in the order $\text{Cd} > \text{Cu}^I > \text{Cr}^{III} > \text{Fe}^{III} > \text{Mn}^{II} > \text{Cu}^{II} > \text{Ni}^{II} > \text{Co}^{II} > \text{Fe}^{II} > \text{Zn} > \text{Mg} > \text{Ca} > \text{Be} > \text{Sr} > \text{Na}$. The higher is the temp. of saturation of the solution, the greater is the concn. of added salt necessary to modify the crystal form. R. T.

Theory of diffusion in solids. I. Dependence of the coefficient of diffusion in solids on concentration. G. P. Ilkevitch (*Physical Trans. Ukrain. Acad. Sci.*, 1940, **9**, 29—38).—The diffusion is considered as the statistical result of place exchanges in crystal lattices. Coeffs. are calc. for the mutual interdiffusion of two components; both coeffs. decrease when the concn. of the diffusing substance increases. J. J. B.

Certain singular points on crystallisation curves of solid solutions. N. L. Bowen (*Proc. Nat. Acad. Sci.*, 1941, **27**, 301—309).—Ternary systems in which two of the components form a complete series of solid solutions with a min. m.p., while each of them forms a eutectic with the third component, are considered. The relation between fractional and equilibrium crystallisation is discussed. It is possible to obtain curves of equilibrium crystallisation from those of fractional crystallisation by a simple construction, which is of particular val. in more complex cases. Inflection points on fractionation curves correspond with corner points on equilibrium curves. The physical significance of such points is discussed. A. J. M.

System sodium disilicate-barium disilicate. K. T. Greene and W. R. Morgan (*J. Amer. Ceram. Soc.*, 1941, **24**, 111—116).

—The compounds form a true binary simple eutectic (at 797° and 32% of $\text{BaO} \cdot 2\text{SiO}_2$) without any intermediate compounds in the range studied [800—1418°, the m.p. of $\text{BaO} \cdot 2\text{SiO}_2$ (I)]. In the field of stability of (I), the glasses show a marked tendency to devitrification. Two types of (I) crystals exist, differing only in external form. The quenching method of examination was used. Measurements of η (immersion method) gave vals. from 1.505 for $\text{Na}_2\text{O} \cdot 2\text{SiO}_2$ to 1.610 for (I). J. A. S.

X-Ray study of lime-phosphate and lime-borate glass. J. Biscoe, A. G. Pincus, C. S. Smith, jun., and B. E. Warren (*J. Amer. Ceram. Soc.*, 1941, **24**, 116—119).—In $\text{CaO-P}_2\text{O}_5$ glasses containing 23 and 28% of CaO , each P is tetrahedrally bonded to 4 O at a distance of 1.57 Å, and each O is bonded to either 1 or 2 P. The Ca^{++} are situated in the holes of the P—O network and have ~7 O neighbours. In the $\text{CaO-B}_2\text{O}_3$ glass (25% of CaO) some of the B atoms are triangularly bonded to 3 O atoms and the others are similarly tetrahedrally bonded. J. A. S.

Silicate glasses. Calculation of densities, refractive indices, and dispersions from glass composition.—See B., 1941, I, 405.

Phase equilibria in the system Al—Ag, as studied by thermal analysis and conductivity methods. E. E. Tscherskaschin and G. I. Petrenko (*J. Gen. Chem. Russ.*, 1940, **10**, 1526—1530).—The α -phase is a solid solution of Al in Ag; max. solubility (6%) is at 500°. The β -phase is stable at $>600^\circ$, below which it breaks down to a eutectoid, consisting of γ (8.8% Al) and α -phase (6% Al). The β' -phase, corresponding with AlAg_3 , is stable below 400°, above which it breaks down to α - and γ -phase. The latter is a series of solid solutions of Al in AlAg_3 (limiting [Al] 14.33%). γ -Alloys containing 10—16% of Al disintegrate after a few months of exposure to air at room temp., yielding a powdery mixture of oxides. The δ -phase represents a series of solid solutions of Ag in Al (limiting [Ag] 48%). Conductivity data for tempered and quenched alloys show that the transformation $\alpha + \gamma \rightleftharpoons \beta'$ proceeds very slowly at 350° and 500°. R. T.

Atomic distribution in aluminium-silver alloys during ageing. C. S. Barrett and A. H. Geisler (*J. Appl. Physics*, 1940, **11**, 733—739).—Laue photographs of Al—Ag alloys, rich in Al, during ageing at 20° and 150° show streaks along certain zonal ellipses in addition to the streaks caused by thermal agitation. These can only be explained as due to two-dimensional gratings parallel to planes of the form {111}, which arise during the early stages of the ppt. process. The streaks obtained at 20° are more diffuse than those at 150°, but when ageing takes place at 200° the phenomenon is not observed. At the beginning of the ppt. very thin plate-like nuclei occur on randomly spaced {111} planes. These govern the orientation and shape of the Widmanstätten ppt. The nature of the nuclei is discussed. A. J. M.

Relation between pressure and solubility of gases in liquids. H. Sattler (*Oel u. Kohle*, 1941, **37**, 230—234).—The Kritschewski-Kasarnovski formula (A., 1936, 29) for calculating the solubility of a gas in a liquid has been deduced on strictly thermodynamical principles for the cases of negligible and finite solvent v.p. and for gas mixtures. Analogous pressure formulæ are deduced for the Ostwald, Bunsen, and Kuenen solubility coeffs. R. B. C.

Nomograph for the solubility of sulphur dioxide in water. D. S. Davis (*Ind. Eng. Chem.*, 1941, **33**, 730).—A nomograph relating the partial pressure of SO_2 over its aq. solution with the temp. and composition of the solution has been constructed from the data of Beuschlein and Simenson (A., 1940, I, 206). J. W. S.

Solubility of chlorine in water. R. P. Whitney and J. E. Vivian (*Ind. Eng. Chem.*, 1941, **33**, 741—744).—The solubility of Cl_2 in H_2O at 10°, 15°, 20°, and 25° has been determined by passing various Cl_2 - N_2 mixtures (partial pressure of Cl_2 0.06—1.0 atm.) through H_2O . The results are in accord with literature vals. and with the calc. data of Adams and Edmonds (B., 1937, 906). The hydrolysis const. calc. on the assumption that unhydrolysed Cl_2 obeys Henry's law are \ll those obtained by Jakovkin (*J. Russ. Phys.-Chem. Soc.*, 1900, **32**, 673). An equation which probably permits extrapolation of the solubility to partial pressures of $\text{Cl}_2 > 1$ atm. is derived. J. W. S.

Solubility of carbamide in water. H. Kakinuma (*J. Physical Chem.*, 1941, 45, 1045—1046).—A redetermination of the solubility of $\text{CO}(\text{NH}_2)_2$ in H_2O at 60—80° confirms the data of Shnidman and Sunier (cf. A., 1932, 687). C. R. H.

Retroflex aqueous solubility curves and the respective solubilities of the monohydrate and monodeuterate of manganous sulphate in ordinary and in deuterium water. R. D. Eddy, P. E. Macherer, and A. W. C. Menzies (*J. Physical Chem.*, 1941, 45, 908—915).—The solubilities of $\text{MnSO}_4 \cdot \text{H}_2\text{O}$ in H_2O and of $\text{MnSO}_4 \cdot \text{D}_2\text{O}$ in D_2O have been determined at temp. >70°. The solubility of the hydrate is > that of the deuterate at comparable temp., the difference in solubility increasing with temp. C. R. H.

Solubility in water of the barium, calcium, and magnesium salts of sulphamic acid. G. B. King and J. F. Hooper (*J. Physical Chem.*, 1941, 45, 938—942).—The solubility in H_2O of Ba, Ca, and Mg sulphamates over the range 0—100° has been determined. Solubility increases with rise in temp., the curve for the Ca salt showing a break at $69.40 \pm 0.05^\circ$, the temp. of transition of tetrahydrate into a lower hydrate or, possibly, into anhyd. salt. C. R. H.

Solubility in type I binary systems. E. I. Achumov (*J. Gen. Chem. Russ.*, 1940, 10, 1471—1489).—For the systems A-B, of Tamman's type I, the solubility x of A in B is expressed as $\log x = f_a \phi_a (1 - \theta_a) / 2\theta_a$, and of B in A as $\log (1 - x) = f_b \phi_b (1 - \theta_b) / 2\theta_b$, where $f_{a(b)}$ are empirical coeffs., analogous to Lewis' activity coeffs., $\phi_{a(b)} = Q_{a(b)} / T_{a(b)}$ ($Q_{a(b)}$ is the heat of fusion of A or B, $T_{a(b)}$ their m.p.), and $\theta_{a(b)} = T / T_{a(b)}$, where T is the temp. of the system. Comparisons of solubilities of various substances at the same temp. are misleading; derived solubilities, as calc. from the above formulæ, are more suitable for certain purposes. R. T.

Ethylene and acetylene adsorption in hydrogenation catalysis. E. F. G. Herington (*Trans. Faraday Soc.*, 1941, 37, 361—366).—The geometric conditions for chemisorption of C_2H_4 and C_2H_2 on crystal facets of Ni and Co are discussed, and it is shown that C_2H_4 should be held on the short spacing 2.47 Å. and C_2H_2 on the long spacing 3.50 Å. The different behaviour of the two gases in the Fischer-Tropsch synthesis supports these views. F. L. U.

Sorption of mercury vapour by oxides and salts of metals. V. A. Piankov and M. L. Loevski (*J. Appl. Chem. Russ.*, 1940, 13, 1559—1564).—The effectiveness of various compounds in removing Hg vapour from air rises in the order $\text{PbO}_2 < \text{MnO}_2 < \text{Ag}_2\text{O} < \text{CaOCl}_2$. The effect in the case of CaOCl_2 is not one of sorption, as HgCl is deposited in the tube beyond the layer of salt, and its effectiveness is greatly augmented by the presence of traces of acid gases (0.05% SO_2) in the air. KMnO_4 and CaOCl_2 in solution are effective in concns. of 0.3—0.5%. R. T.

Recovery of volatile solvents by sorption. V. Sorption on and desorption from active charcoal of ethyl acetate. E. V. Alexeevski and A. M. Mintel (*J. Appl. Chem. Russ.*, 1940, 13, 1565—1571).—Hydrolysis of esters (EtOAc and $\text{C}_2\text{H}_{11} \cdot \text{OAc}$) by boiling H_2O in presence of active C is < in its absence, except in the case of C activated with ZnCl_2 . Desorption by means of steam at 110—120° is practically quant. in the case of C activated with H_3PO_4 , but not with ZnCl_2 . R. T.

Composition of Prussian and Turnbull's blues. IV. Adsorptive properties. A. K. Bhattacharya (*J. Indian Chem. Soc.*, 1941, 18, 71—75; cf. A., 1933, 920).—Prussian blue (I) prepared by mixing equiv. proportions of FeCl_3 and $\text{K}_4\text{Fe}(\text{CN})_6$ shows positive adsorption of both FeCl_3 and $\text{K}_4\text{Fe}(\text{CN})_6$, but when prepared in presence of excess of FeCl_3 shows negative adsorption of FeCl_3 . Turnbull's blue (II) prepared by mixing equiv. proportions of FeSO_4 and $\text{K}_3\text{Fe}(\text{CN})_6$ shows positive adsorption of $\text{K}_3\text{Fe}(\text{CN})_6$ and negative adsorption of FeSO_4 . The results support the view that both adsorption and oxidation-reduction reactions modify the final compositions of both (I) and (II). J. W. S.

Adsorption of potassium xanthate by galena.—See B., 1941, I, 402.

Surface tension of capillary-active organic halides. E. A. Hauser and G. E. Niles (*J. Physical Chem.*, 1941, 45, 954—959).—The surface tension (σ) of aq. solutions of cetyl, cetylpyridinium, and cetyltrimethylammonium chloride, bromide,

and iodide is recorded graphically. In each case σ decreases with increase in solute concn. C. R. H.

Tension mechanisms responsible for lens formation and a new method for measuring the angles of liquid lenses. N. F. Miller (*J. Physical Chem.*, 1941, 45, 1025—1045; cf. A., 1941, I, 166).—Earlier theories of lens formation and the spreading of liquids are discussed, and a theory limited to systems of two liquids of low mutual solubility where the liquid with the higher surface tension is the substrate is developed. Where lens formation occurs the magnitude of the total lens angle (θ) depends on the free energy decrease consequent on mol. orientation in the film on the substrate. A new method of measuring θ is described and data for ten org. liquids on H_2O which are presented agree with calc. vals. of θ . Vals. of 143 angles (corr. to $\pm 0.01^\circ$) of spherical segments of vols. 0.0005—0.0200 c.c. and of widths 0.25—1.00 cm. are tabulated. C. R. H.

Properties of films of helium II. A. K. Kikoin and B. G. Lasarev (*Physical Trans. Ukrain. Acad. Sci.*, 1940, 9, 101—106).—Further experiments on films rising along the walls of a body immersed in liquid He II are reported (cf. A., 1938, I, 511). Films are formed on Ag, celluloid, and glass. The heating current required to destroy them is higher for Ag than for insulators. The film moves on the surface with a velocity $\sim 10^4$ cm. per sec. J. J. B.

Cuprous-cupric oxide films on copper. C. G. Cruzan and H. A. Miley (*J. Appl. Physics*, 1940, 11, 631—634).—The composition of oxide films on an abraded Cu surface heated in air, or in air- O_2 and air- N_2 mixtures, has been studied by the electrolytic reduction method. Films <400 Å. in thickness consist of Cu_2O only, all films >800 Å. contain CuO and Cu_2O , and films of intermediate thickness may or may not contain CuO . The thickness of film obtained with a given time of heating increases with the $[\text{O}_2]$. The thickness of the film and the presence or absence of CuO are also affected in some degree by factors which influence the perviousness of the film and by previous thermal treatment. L. J. J.

Surface films of cerin, friedelin, and related substances.—See A., 1941, II, 265.

Structure of condensed unimolecular films. A. E. Alexander (*Trans. Faraday Soc.*, 1941, 37, 426—437).—Theories advanced to explain the force-area and surface potential-area curves of condensed monolayers are reviewed and discussed. The close correlation between two- and three-dimensional structures suggested by Dervichian (A., 1940, I, 22) is neither to be expected nor is it supported by recent experimental work. A no. of groups of compounds for which both force-area and surface potential data are available are discussed in detail, with special reference to the mode of packing and the dipole orientation. F. L. U.

Effect of monolayers of insoluble substances on the stability of bubbles (elements of foam). A. A. Trapeznikov (*Acta Physicochim. U.R.S.S.*, 1940, 13, 265—293).—Those substances which form brittle monolayers are less effective in stabilising foams than those which form liquid monolayers, conditions for stabilisation being the ability to form a continuous, mobile layer which can flow rapidly and without break of continuity into any ruptures that occur. Factors which influence the forces stretching the layers, e.g., hydration of polar groups, local thinning of the liquid film, liquid drainage, and ageing of the adsorption layers, are discussed with reference to foam stability. C. R. H.

Charge on aerosol particles in a dipolar ionic atmosphere. P. Lissovski (*Acta Physicochim. U.R.S.S.*, 1940, 13, 157—192).—Mainly theoretical. Formulae for the average val. of the particle charge, for the ion concn. in the aerosol, and for the kinetics of the change in ion concn. and of the charging process have been derived. Data for radioactively charged mineral oil aerosols, which were obtained by ultramicroscopic and photographic oscillation methods, indicate that charging of the particles is not symmetrical, $\sim 10\%$ more negatively charged than positively charged particles being formed. The calc. distribution of charge is in good agreement with that found experimentally. C. R. H.

Optical properties of colloidal suspensions in relation to the measurement of particle-size frequency. E. G. Richardson (*J. Appl. Physics*, 1940, 11, 653—657).—Extinction coeffs. for a no. of suspensions of TiO_2 , S, and clay of known particle

size have been measured. The results are applied to the particle-size analysis of clay and pigment suspensions by extinction measurements carried out in a centrifuge.

L. J. J.
Preparation of organosols of heavy metals. E. M. Natanson (*Ber. Inst. Chem. Ukrain. Akad. Wiss.*, 1940, 7, 311—323).—Org. solvent is placed on top of an aq. salt solution in a beaker in which the cathode (a metal rod) vibrates up and down. The aq. layer contains the anode, and when the cathode is immersed in it a spongy deposit of the metal is obtained; when next the cathode returns to the org. layer the deposit disperses itself in the latter. The dispersion is promoted by detergents in the org. liquid. C_6H_6 , PhMe, castor oil, etc. were employed, and sols of Fe, Ni, Co, Pb, Bi, Sn, Ag, and Pt obtained.
 J. J. B.

Nature of resin solutions in organic solvents.—See B., 1941, II, 12.

Inter-relationships in the reactions of horse hæmoglobin.—See A., 1941, III, 794.

Electro-optical field mapping. H. Mueller (*J. Opt. Soc. Amer.*, 1941, 31, 286—291).—Dilution of gels of yellow bentonite in which the particles are <20 μ . in diameter gives a solution of Kerr const. 10 e.s.u. for 60-cycle a.c. fields. The high electro-optical birefringence enables inhomogeneous electric fields to be measured and studied. Isoclinic and isochromatic lines obtained by observation with crossed Polaroids give field direction and intensity at any point in the field. A.c. potentials <200 v. suffice.

L. J. J.
Influence of alcohols on the precipitate formation of the hydroxides of aluminium and iron. T. Katsurai and M. Fuda (*Sci. Papers Inst. Phys. Chem. Res. Tokyo*, 1941, 38, 328—330).—5 ml. of $N-AlCl_3$ or $-FeCl_3$ and 45 ml. of H_2O (MeOH, EtOH) are mixed with 5 ml. of N -aq. NH_3 and 45 ml. of H_2O (MeOH, EtOH) and the sedimentation vol. (R) is determined. R increases in presence of alcohol. When a $Fe^{II}-Fe^{III}$ mixture ($N-FeSO_4$ and $3N-FeCl_3$) is added to $7.5N$ -aq. NH_3 in H_2O , MeOH, or EtOH, R increases in presence of alcohol and the ppt. formed is magnetic in H_2O but in alcohol is non-magnetic to a magnet inserted in the supernatant liquid.
 W. R. A.

Irregular series in colloidal solutions by [the action of] electrolytes. III. Mercuric sulphide sols of various origin. N. Sata and K. Mōri (*Bull. Chem. Soc. Japan*, 1941, 16, 139—143; cf. A., 1940, I, 411).—Similar irregular series are obtained by the action of $AgNO_3$ on HgS sols prepared from $HgCl_2$, $HgSO_4$, $Hg(NO_3)_2$, and from carefully purified $Hg(CN)_2$. The phenomenon is considered not to depend on the presence of impurities nor, since the coagulating ion is univalent, on reversal of charge due to adsorption.
 F. L. U.

Periodic formation of deposits from solutions during their evaporation. III. N. F. Jermolenko, F. M. Laguto, M. N. Tiumentzeva, and S. Romanovitsch (*J. Gen. Chem. Russ.*, 1940, 10, 1565—1567).—Solutions of $PhOH$ and $C_{10}H_8$ in the alcohols ROH are evaporated in watch glasses at temp. $10^\circ <$ the b.p. of the solvent and at 50° , and the no. of rings formed is counted. It rises in the series $R = H < Me < Et < Pr^{\beta} < Pr^{\alpha} < Bu^{\beta} < Bu^{\alpha} < C_5H_{11}$; the reverse order holds for the surface tension of the solvents.
 R. T.

Effect of formaldehyde on the isoelectric points of some proteins, determined by microelectrophoresis. S. J. Circle and A. K. Smith (*J. Physical Chem.*, 1941, 45, 916—930).—The general effect of addition of 10% of CH_2O to proteins is to lower the isoelectric point 0.1—0.7 pH unit. Of the proteins investigated, viz., oil-free soya-bean meal, several soya-bean proteins, casein, gelatin, and ovalbumin, only the first was unaffected by CH_2O . Gelatin was unaffected by 5% of CH_2O and even with 20% of CH_2O the lowering of the isoelectric point was only 0.1 pH unit. The greatest lowering was observed with electrodialysed ovalbumin and soya-bean "whey."
 C. R. H.

Electrophoretic study of elementary bodies of vaccinia. Mixtures of elementary bodies of vaccinia and coated colloid particles.—See A., 1941, III, 630.

Electrokinetics. XXV. Electroviscous effect. II. Systems of calcium and sodium caseinates. C. L. Hankinson and D. R. Briggs (*J. Physical Chem.*, 1941, 45, 943—953).—Sp. conductivity, relative η , and electrokinetic potential data at 30° for solutions of Ca and Na caseinate in presence of $CaCl_2$

and $NaCl$ respectively give straight lines when calc. and plotted as variables in the linear form of the electroviscosity equation (cf. A., 1941, I, 335). Electro- η accounts for 59% and 38% of the sp. η in 1% Ca and Na caseinate respectively. The conclusions which can be drawn from the data concerning combination between H_2O and colloid particles and the change in micelle size with concn. are similar to those drawn from data on Na gum arabic (*loc. cit.*).
 C. R. H.

VI.—KINETIC THEORY. THERMODYNAMICS.

Free energy of methyl cyanide and equilibrium constants of related reactions. H. W. Thompson (*Trans. Faraday Soc.*, 1941, 37, 344—352).—Thermodynamic functions of CH_4 , C_2H_4 , C_2H_6 , C_2N_2 , and NH_3 are calc. from recent mol. data, and the entropy, free energy, and sp. heat of MeCN are obtained from the known moments of inertia and mol. vibration frequencies. Using the vals. so obtained, the gaseous equilibria $CH_4 + C_2N_2 \rightleftharpoons MeCN + HCN$, $2CH_4 + C_2N_2 \rightleftharpoons 2MeCN + H_2$, $C_2H_4 + 2HCN \rightleftharpoons 2MeCN$, $CH_4 + HCN \rightleftharpoons MeCN + H_2$, $C_2H_6 + C_2N_2 \rightleftharpoons 2MeCN$, $2C(\beta\text{-graphite}) + NH_3 \rightleftharpoons MeCN$, $CH_4 + CNCl \rightleftharpoons MeCN + HCl$, and $CH_4 + CNCl \rightleftharpoons MeCl + HCN$ are discussed and their equilibrium consts. computed.
 F. L. U.

Dissociation of sulphuryl chloride. H. W. Thompson (*Trans. Faraday Soc.*, 1941, 37, 340—343).—The free energy of SO_2Cl_2 is calc. statistically from mol. data, and by combining the results with thermodynamic data for SO_2 and Cl_2 the equilibrium const. for the dissociation is obtained. Calc. and measured vals. show poor agreement, and the discrepancy is discussed.
 F. L. U.

Physico-chemical study of the system aluminium bromide and sodium iodide in ethyl bromide. V. A. Plotnikov and V. N. Dumarevskaja (*Ber. Inst. Chem. Ukrain. Akad. Wiss.*, 1940, 7, 383—397).—The solubility of NaI in $AlBr_3$ - $EtBr$ mixtures has a max. (12.9% of the resulting solution) in the mixture $AlBr_3$ 35, $EtBr$ 65 wt.-%. If NaI is gradually added to an $AlBr_3$ - $EtBr$ mixture, the electrical conductivity (κ) passes through a max. when the mol. ratio $[NaI] : [AlBr_3] = 1 : 2$; κ of the solution $NaI : AlBr_3 : EtBr = 0.135 : 0.27 : 1$ is $1.2 \times 10^{-2} \Omega^{-1} \text{ cm.}^{-1}$ at 18° . From the increase of the b.p. of $EtBr$ the calc. mol. wt. of a mixture $[NaI] : [AlBr_3] = 1 : 20$ was 239, for $[NaI] : [AlBr_3] = 1 : 2$ 345, and for $[NaI] : [AlBr_3] = 1 : 1.6$ 315. The first low val. is presumably due to electrolytic dissociation, and the third high val. to complex formation. The second val. is half of the mol. wt. of Al_2Br_6NaI ; presumably this compound is totally dissociated into Na^+ and $[Al_2Br_6I]^-$. If the $[NaI]$ is low, Al can be electrolytically deposited from the solutions as black dendrites; at high $[NaI]$ no electrodeposition occurs.
 J. J. B.

Temperature-dependence of the ionisation constants of monocarboxylic acids. J. F. J. Dippy and H. O. Jenkins (*Trans. Faraday Soc.*, 1941, 37, 366—373).—Data for the variation of the ionisation consts. of monocarboxylic acids with temp. are reviewed and critically discussed. The practice of employing thermodynamic ionisation const. data for a fixed temp. and for aq. solution as a measure of true acid strength is defended.
 F. L. U.

Thermodynamics of acid-base equilibria. D. H. Everett and W. F. K. Wynne-Jones (*Trans. Faraday Soc.*, 1941, 37, 373—375).—The contention of Dippy and Jenkins (preceding abstract) is criticised on the ground that inversions of acid strength with change of temp., examples of which are cited, are fairly common. A true comparison requires an exact knowledge of the various thermodynamic functions relating to ionisation.
 F. L. U.

Dissociation constant of hydroxylamine. H. Hagiwara (*Bull. Inst. Phys. Chem. Res. Japan*, 1941, 20, 251—255).—The hydrolysis const. K_h of NH_2OH , determined at 25° by pH measurements on solutions of various concn. by the glass electrode, is 1.04×10^{-6} . The dissociation const. of NH_2OH is 0.97×10^{-8} when calc. from K_h , and 0.87×10^{-8} when calc. from the distribution equilibrium of HCl between aq. NH_3 and NH_2OH .
 W. R. A.

Dissociation constants of hydrazine. N. Yui (*Bull. Inst. Phys. Chem. Res. Japan*, 1941, 20, 256—263).—The dissociation consts. (K_1 and K_2) of N_2H_4 have been determined by measuring with a glass electrode at 25° the pH variation on

titrating $N_2H_4 \cdot HCl$ with HCl and $NaOH$, using the cell $Hg|Hg_2Cl_2 + KCl$ (saturated)| $0.1N\text{-}AcOH + 0.1N\text{-}NaOAc$ |glass|aq. $N_2H_4 \cdot HCl|KCl$ (saturated) + $Hg_2Cl_2|Hg$. The mean vals. of K_1 and K_2 are 8.63×10^{-7} and 1.86×10^{-14} . Vals. of ΔG_{298}° of 8277 and 18,741 g.-cal. are given, respectively, for the reactions $N_2H_4 + H_2O = N_2H_5^+ + OH^-$ and $N_2H_5^+ + H_2O = N_2H_6^{2+} + OH^-$. W. R. A.

Thermodynamic study of bivalent metal halides in aqueous solution. VIII. Activity coefficient of ferrous chloride. R. H. Stokes and R. A. Robinson (*Trans. Faraday Soc.*, 1941, **37**, 419—421; cf. A., 1941, I, 15).—Activity coeffs. of $FeCl_2$ at 25° are tabulated for aq. solutions 0.1—2.0 M. $FeCl_2$ occupies a regular position in the series Mn, Fe, Co, and Ni chlorides. A modification of the isopiestic v.p. method is described in which access of atm. O_2 is avoided. F. L. U.

Constitution diagrams and composition of methane and ethane hydrates. O. L. Roberts, E. R. Brownscombe, and L. S. Howe (*Oil and Gas J.*, 1940, **39**, No. 30, 37—40, 43).—Phase diagrams over the range 10—60° F. have been determined for the systems $CH_4\text{-}H_2O$ and $C_2H_6\text{-}H_2O$. The triple points for ice, liquid H_2O , and solid hydrate are ~ 375 lb./in.² and 32° F. for $CH_4 \cdot 7H_2O$ (I) and ~ 75 lb./sq. in.² and 32° F. for $C_2H_6 \cdot 7H_2O$ (II). The compressibility factor for C_2H_6 falls from $\sim 0.95/5$ atm. to $\sim 0.68/24$ atm. at 32° F. and to $\sim 0.60/32$ atm. at 54° F. At 32° F. the heats of formation from the gas and liquid H_2O are: (I) 14,500 g.-cal. per mol.; (II) 16,300 g.-cal. per mol. A. R. Pe.

System naphthalene-benzene considered as an ideal solution. A. N. Campbell (*Canad. J. Res.*, 1941, **19**, A, 143—149).—The v.p. and vapour composition for various solutions of $C_{10}H_8$ in C_6H_6 have been measured at various temp. Raoult's law is followed closely by $C_{10}H_8$ up to high $[C_6H_6]$. The d , η , and γ , measured at 79.5°, show fairly close but not exact additivity. The results are contrasted with those for $p\text{-}OH \cdot C_6H_4 \cdot NO_2\text{-}C_{10}H_8$ mixtures (A., 1941, I, 211) and it is considered that ideal behaviour is observed in mixtures of which both components have a low dipole moment (μ), but that pronounced deviations from Raoult's law are observed in systems of which one component has a high μ . Deviations from Raoult's law, however, are not necessarily associated with marked departures from additivity in properties not dependent on v.p. J. W. S.

Equilibrium curves of the system styrene-ethylbenzene. I. I. Zeidler, L. A. Komissarova, and N. N. Golubitzkaja (*J. Appl. Chem. Russ.*, 1940, **13**, 1699—1702).—The composition of the liquid and vapour phases has been determined at the b.p. at 50 and 90 mm. The equilibrium curves deviate negatively from the theoretical, more so at 90 than at 50 mm. No appreciable polymerisation of styrene is observed at the b.p. at 90 mm., and this pressure is recommended for fractionation of the mixtures. R. T.

Equilibrium between metallic aluminium and zinc chloride in melts. J. K. Delimarski and L. S. Berenblum (*Ber. Inst. Chem. Ukrain. Akad. Wiss.*, 1940, **7**, 375—382).—Mixtures of Al, Zn, and either $AlCl_3 + NaCl$ or $ZnCl_2 + NaCl$ were heated at 550—600°, and the composition of the metal and the salt phases was determined. Al easily displaces Zn from $ZnCl_2$. The theoretical const. $[Al]^2[ZnCl_2]^3/[Zn]^2[AlCl_3]^3$ rapidly increases with $[Zn]$; it is 10^{-12} — 10^{-11} at 550° and $\sim 10^{-7}$ at 600°. J. J. B.

Physico-chemical properties of rare metals. II. Systems $ZrCl_4\text{-}NaCl$ and $ZrO_2\text{-}CaCl_2$. N. A. Belozerski and O. A. Kutscherenko (*J. Appl. Chem. Russ.*, 1940, **13**, 1552—1555).—The occurrence of 4:1 and 1:1 compounds, m.p. 535° and 330°, respectively, in the system $NaCl\text{-}ZrCl_4$ is established. ZrO_2 is almost insol. in molten $CaCl_2$ at 770°. R. T.

Molecular compounds of phenylacetic acid and its salts.—See A., 1941, II, 223.

Equilibria in the system $NH_4F\text{-}AlF_3\text{-}H_2O$, at 25°. A. V. Novoselova (*J. Gen. Chem. Russ.*, 1940, **10**, 1547—1550).—The salts $AlF_3 \cdot 3H_2O$, NH_4AlF_4 , $2NH_4F \cdot AlF_3 \cdot H_2O$, and $(NH_4)_3AlF_6$ are formed in systems containing AlF_3 $\geq 2\%$ and NH_4F $\geq 4\%$, at 25°. The solubility of these salts is recorded. R. T.

Solid solutions in the ternary system $ZnS\text{-}CdS\text{-}MnS$. F. A. Kröger (*Z. Krist.*, 1939, **102**, 132—135; cf. A., 1939, I, 464; 1940, I, 96; Schnaase, A., 1933, 341).—At 900° the phase diagram has two regions corresponding with separation of

green MnS and red $ZnS\text{-}CdS\text{-}MnS$ mixed crystals (I). (I), which contain ≥ 50 mol.-% of MnS , have the wurtzite structure except near the ZnS corner, where a sphalerite X-radiogram is obtained. The a vals. obey Vegard's law, but the observed c vals. are slightly $<$ the calc. vals. The demixing is ascribed to a difference in the linkings in MnS and (I), which are predominantly hetero- and homo-polar, respectively. Each Zn or Cd must be surrounded by ≤ 6 other Zn or Cd atoms to give a stable homopolar structure. A. J. E. W.

Simplified solution for four-component Jaenecke phase diagrams. H. Buraus (*J. Physical Chem.*, 1941, **45**, 968—977).—Mathematical. An analytical method of solving four-component reciprocal salt-pair phase rule problems is derived. C. R. H.

VII.—ELECTROCHEMISTRY.

Conductivity of ethyl thiocyanate solutions. B. D. Alegran (*J. Gen. Chem. Russ.*, 1940, **10**, 1531—1534).—Conductivity in the systems $AlBr_3\text{-}EtCNS$ and $AlBr_3\text{-}KBr\text{-}, -KI\text{-}$, and $-KCNS\text{-}EtCNS$ is of the same order as for the corresponding solutions in $EtBr$ or EtI . R. T.

Electrochemical investigation of xylene solutions. V. A. Plotnikov and A. T. Dibrova (*Ber. Inst. Chem. Ukrain. Akad. Wiss.*, 1940, **7**, 337—350).—The conductivity of salt solutions in xylene (I) increases with the salt concn. The most concn. solutions had the mol. ratios $NaBr : AlBr_3 : (I) = 0.29 : 1 : 2$, $NH_4Br : AlBr_3 : (I) = 0.34 : 1 : 2$, $KBr : AlBr_3 : (I) = 0.43 : 1 : 2$, $NaCl : AlBr_3 : (I) = 0.41 : 1 : 167$, $NH_4Cl : AlBr_3 : (I) = 0.44 : 1 : 2$, $KCl : AlBr_3 : (I) = 0.41 : 1 : 2$, and $NH_4I : AlBr_3 : (I) = 0.34 : 1 : 3$. The κ of these solutions at an unspecified temp. is $2\text{--}4 \times 10^{-3} \Omega^{-1} \text{cm}^{-1}$. The decomp. voltage of systems containing $AlBr_3$ alone or with addition of NH_4I , NH_4Br , or KCl is 1.64—1.68 v.; obviously no exchange of halogen between $AlBr_3$ and NH_4I takes place. From $AlBr_3$ solutions in (I), better when NH_4I is present, glossy Al is electrolytically deposited with a high yield. J. J. B.

Variation of the electric conductivity of aluminium bromide solutions in xylene. V. A. Plotnikov and E. B. Gitman (*Ber. Inst. Chem. Ukrain. Akad. Wiss.*, 1940, **7**, 351—361).—The conductivity of 29 mol.-% $AlBr_3$ in xylene increases with time and reaches in ~ 3 weeks vals. 15—70 times as high as the original. The rate of the increase can be represented by an equation of a unimol. reaction, but the velocity coeff. is different for the first and the second halves of the process. Presumably first the reaction $[AlBr_3] + \text{xylene} \rightarrow [AlBr_2 \cdot \text{xylene}]Br$ and then $[AlBr_2 \cdot \text{xylene}]Br + \text{xylene} \rightarrow [AlBr_2 \cdot 2\text{xylene}]Br_2$ takes place. J. J. B.

Electrochemical study of the system $TlBr\text{-}AlBr_3$ in benzene. V. A. Plotnikov and B. V. Spektor (*Ber. Inst. Chem. Ukrain. Akad. Wiss.*, 1940, **7**, 429—437).—When $TlBr$ is added to an $AlBr_3$ solution in C_6H_6 two layers form, the upper one containing only $AlBr_3$ in C_6H_6 , and the lower one $TlBr$ and $AlBr_3$ in C_6H_6 ; the highest ratio $[TlBr] : [AlBr_3]$ obtainable was 1:2. From these solutions crystals of the compound $TlBr \cdot AlBr_3 \cdot 2C_6H_6$ separate. The conductivity of $AlBr_3\text{-}C_6H_6$ solutions is strongly increased by $TlBr$; a mixture containing 0.48 mol. of $TlBr + 1AlBr_3 + 4 \cdot 2C_6H_6$ has at 40° $\kappa = 12 \times 10^{-3} \Omega^{-1} \text{cm}^{-1}$. The decomp. voltage of similar solutions is 1.8 v. The cathodic deposit consists chiefly of Tl. J. J. B.

The reversible glass-sodium electrode. E. M. Skobetz and N. S. Kavetzki (*Ber. Inst. Chem. Ukrain. Akad. Wiss.*, 1940, **7**, 287—298).—A thin glass bulb is blown out at an end of capillary, filled with Na, sealed, and heated to cause the Na_2O or $NaOH$ present in the Na to react with the glass; a Pt or Cu wire connects the Na ingot with the outside. The resistance of the glass layer may be some 5000 Ω . at 300°; at lower temp. it is much higher. The cell $Na|glass|AlBr_3 70, NaBr 30 \text{ mol.-%}|Al$ has an e.m.f. of 2.71 v. at 165° and 2.76 v. at 255°. Instead of Na a Na amalgam can be used. The following e.m.f. (temp. in parentheses) are given by the cell 49 wt.-% Na amalgam|glass| $AlBr_3 70, NaBr 30 \text{ mol.-%}$, metal bromide 10 wt.-%|metal: Al 1.61 (220°), 1.58 (300°); Zn 1.66 (200°), 1.65 (313°); Cd 1.74 (200°), 1.72 (315°); Pb 1.76 (200°), 1.77 (300°); Sn 1.87 (200°), 1.88 (300°); Ag 2.08 (200°), 2.04 (310°); Bi 2.22 (200°), 2.22 (305°); Cu 2.32 (250°), 2.32 (315°); Hg 2.33 (200°), 2.35 v. (300°). The Na

amalgam-glass electrode was also used for determining the decomp. potential of an AlCl_3 -NaCl melt at 280° .

J. J. B.

Use of glass membranes for measuring the decomposition voltage of fused salts. N. G. Tschovnik and D. S. Pelkis (*Ber. Inst. Chem. Ukrain. Akad. Wiss.*, 1940, 7, 325—336, and *J. Gen. Chem. Russ.*, 1940, 10, 1443—1448).—The catholyte was inside, and the anolyte outside, a glass test-tube. Graphite electrodes were used. The decomp. voltage of PbCl_2 71.5, NaCl 28.5 mol.-% is 1.37 v. at 426° and 1.30 at 620° ; for the equimol. mixture of PbCl_2 and KCl it is 1.38 at 412° and 1.28 at 565° . These vals. are slightly < the e.m.f. of the cell $\text{Pb}|\text{PbCl}_2, \text{KCl}|\text{glass}|\text{PbCl}_2, \text{KCl}|\text{Cl}_2$ but > that of $\text{Pb}|\text{PbCl}_2, \text{KCl}|\text{Cl}_2$. J. J. B.

Physico-chemical properties of rare metals. I. Decomposition potential of molten tantalum chloride. N. A. Belozerski and K. I. Rezvaja (*J. Appl. Chem. Russ.*, 1940, 13, 1545—1551).—The decomp. potential of TaCl_5 at 195 — 306° , in an atm. of Cl_2 , was determined, using a special apparatus, described. The heat of formation of TaCl_5 and the free energy and entropy of the process are hence derived.

R. T.

Redox potential of iodine. A. L. Rotinian and I. I. Appenin (*J. Gen. Chem. Russ.*, 1940, 10, 1524—1525).—The vals. given by Rusanova (A., 1940, 1, 75) are ~ 10 mv. > the actual vals.

R. T.

Photovoltaic effects in dye solutions. B. S. V. R. Rao (*Current Sci.*, 1941, 10, 200).—Photo-potentials (E_p) for methylene-blue and Me- and malachite-green illuminated with filtered and unfiltered light from a Hg arc have been measured with a vac.-tube voltmeter. The E_p max. is at a slightly higher λ than the absorption max. in each case. The general photovoltaic behaviour of the dyes resembles that of dyes examined previously (A., 1934, 740). A. J. E. W.

Depression of maxima of polarographic curves, and displacement of the reduction potential of ions in curves connecting current density with voltage. J. P. Gochshtein (*J. Gen. Chem. Russ.*, 1940, 10, 1663—1667).—The potential of deposition of Zn or H at a Hg cathode becomes more negative in presence of TI^+ at $p_{\text{HI}} < 3$. This is associated with the electro-capillary action of TI^+ ; the depression of the max. for TI^+ by PO_4^{3-} or Al^{3+} is ascribed to the same cause.

R. T.

Effect of anions on reduction of nitrate ion at a dropping mercury cathode. J. P. Gochshtein (*J. Gen. Chem. Russ.*, 1940, 10, 1657—1662).—Two waves are observed in the polarographic curve obtained for KNO_3 - LaCl_3 solutions; the first wave is due to reduction of a complex ion, probably $[(\text{LaNO}_3)_2]^{4+}$, and the second to adsorption phenomena at the cathode. The height of the first wave rises with increasing concn. of added salts (KCN , $\text{Na}_2\text{S}_2\text{O}_3$, Na_2SO_4) to a certain limiting concn., above which it again falls.

R. T.

Polarographic behaviour of histidine and other amino-acids. E. R. Roberts (*Trans. Faraday Soc.*, 1941, 37, 353—357).—Polarograms of histidine (I) exhibit three characteristic waves, the heights of two of which vary linearly with $[(\text{I})]$, and one of these can be used to determine (I) in presence of arginine and lysine. Cystine, in solutions buffered with NH_4Cl and NH_3 and containing CoCl_2 , yields polarograms which are reproducible only with freshly prepared solutions. The polarographic method is not suitable for serine, tryptophan, and tyrosine.

F. L. U.

Hydrogen overvoltage at high current densities. IV. Influence of concentration, anions, temperature, and catalytic poisons. A. Hickling and F. W. Salt (*Trans. Faraday Soc.*, 1941, 37, 333—339; cf. A., 1941, 1, 301).—Variation of the kind of acid or its concn. does not appreciably affect H overvoltage (η) at Hg, W, or platinised Pt in the c.d. range 0.001—1 amp. per sq. cm., except when the c.d. is high enough and the concn. low enough to cause concn. polarisation. Rise of temp. to 70° causes a decrease of η with Hg and Sn corresponding with an average temp. coeff. of -0.002 v. per degree, a smaller decrease with W, and no measurable effect with Pt. Addition of As_2O_3 , HgCl_2 , or CS_2 raises η at Pt considerably and increases the slope of the η -log c.d. graph.

F. L. U.

Electrolytic deposition of a vanadium-aluminium alloy. V. A. Plotnikov and V. V. Liulka (*Ber. Inst. Chem. Ukrain. Akad. Wiss.*, 1940, 7, 399—405).—Electrolysis of mixtures of

AlBr_3 67, KBr 33 mol.-% and V_2O_5 5—12 wt.-%, using a Fe-V anode and a Cu cathode, gives at 200° and a c.d. 5—50 amp. per sq. dm. deposits consisting chiefly of VO_2 . If the electrolyte contains no V_2O_5 but Fe-V anodes are employed, from $2\text{AlBr}_3, \text{KBr}$ and $2\text{AlBr}_3, \text{NaBr}$ Al containing but little V is deposited, and from $2\text{AlCl}_3, \text{NaCl}$ a black powder containing Al and 40% of V is obtained. The decomp. voltage of the $2\text{AlCl}_3, \text{NaCl}$ melt at 233° was 2.4 v., but when a Fe-V anode was used a second kink at 2.8 v. was observed after 1 amp.-hr. had passed, obviously due to the discharge of V ions.

J. J. B.

VIII.—REACTIONS.

The Arrhenius equation and the active complex method. M. Temkin (*Acta Physicochim. U.R.S.S.*, 1940, 13, 733—746).—The active complex method is applied to the derivation of the Arrhenius equation, which is obtained in the form $d \log_e k/dT = (\epsilon_i - \epsilon_0)/kT^2$, in which ϵ_i and ϵ_0 denote the average energy of active complexes and initial mols. respectively; the equation is valid for any reaction order. The same method is used to evaluate the integration const.

F. L. U.

Homogeneous isotopic interchange reaction between hydrogen and heavy alkaline solution. S. Abe (*Sci. Papers Inst. Japan, Phys. Chem. Res. Tokyo*, 1941, 38, 287—297).—The transfer of D_2 from n-KOH in D_2O to H_2 is probably due to isotopic interchange reaction taking place in the liquid phase. The rate of transfer at 100° decreases with pressure of H_2 and on pretreatment of KOH. The decrease is accompanied by an increased deposition of a flaky ppt. and the rate is immeasurable when fresh pptn. is no longer observable. The reaction is not an example of acid-base catalysis, but more probably is due to catalysis by colloidal Fe in the KOH. Pptn. of Fe as hydroxide is discussed for various experimental arrangements.

W. R. A.

Homogeneous [isotopic] interchange reaction between hydrogen and water. S. Abe (*Bull. Inst. Phys. Chem. Res. Japan*, 1941, 20, 264—276).—When H_2 reacts with n-KOH, n-HCl (both in D_2O), or D_2O at 100° in a vac. for several hr., the D content of H_2 is altered in alkaline solution and the amount of D_2 transferred is \propto vol. of solution. Different alkali preps. give quite different sp. rates. Sp. rates are (i) diminished by S or H_2S , (ii) rapidly decreased by H_2 pressure, and (iii) decreased to the extent of becoming immeasurable by pretreatment of the solution. The proposed mechanism involves catalysis by colloidal Fe (cf. preceding abstract). W. R. A.

Kinetics and mechanism of redox reactions. V. Oxidation of the ferrous ion by dichromate. V. F. Stefanovski (*J. Gen. Chem. Russ.*, 1940, 10, 1621—1630).—The velocity of the reaction of oxidation of FeSO_4 in acid solution by $\text{K}_2\text{Cr}_2\text{O}_7$ is expressed by $k[\text{Cr}^{VI}][\text{Fe}^{II}]^2[\text{H}^+]^2$.

R. T.

Kinetic foundations of the method of isotopic indicators. I. Kinetics of exchange reactions. S. Z. Roginski (*Acta Physicochim. U.R.S.S.*, 1941, 14, 1—26; cf. A., 1941, 1, 271).—Theoretical. If the isotopes may be regarded as identical in physicochemical properties, so that the condition for equilibrium is equipartition throughout all mol. species, then the kinetic equations for exchange reactions must take very simple forms even under conditions far removed from ideality. When, as in work with radioactive indicators, the concn. of the isotope undergoing exchange is very small, a further simplification is introduced, and in this case the exchange reaction will always follow a unimol. course irrespective of its mechanism, even when heterogeneous. The dependence of the unimol. velocity coeff. on initial concn. may in certain cases give information about activity coeffs. in solution, adsorption equilibria, etc.

F. J. G.

Acid hydrolysis of methyl acetate in dioxan-water mixtures. H. S. Harned and A. M. Ross, jun. (*J. Amer. Chem. Soc.*, 1941, 63, 1993—1999).—Reaction velocity coeffs. (k) of the hydrolysis of MeOAc catalysed by 0.1M- and 0.2M-HCl at 25° and 35° in aq. dioxan, containing 0—90% of dioxan, have been determined. The relative activity coeff. of MeOAc at 25° has been determined by v.p. measurements using a new technique. $k \propto [\text{HCl}]$ in all dioxan- H_2O mixtures in moderately dil. acid solution. The activation energy is approx. independent of the composition of the solvent mixture. The activity coeff. (γ^*) of the transition complex is computed from the Brönsted equation and existing data and varies

approx. similarly with the activity coefficient (γ_{HCl}) of HCl and H₂O with composition of the solvent. γ^* and γ_{HCl} , computed for KCl, NaCl, and LiCl solutions, behave similarly with composition of solution as for dioxan-H₂O mixtures and support the validity of the Brönsted equation. W. R. A.

Chemistry of macromolecules. H. W. Melville (*J.C.S.*, 1941, 414—426).—Tilden lecture. The mechanism of polymerisation and interpolymerisation reactions leading to the formation of macromols. is discussed. The methods and results of determinations of the mol. wt. of the products are described. The formation of three-dimensional polymerides is discussed. O. D. S.

Ammonolysis of halogen fatty acids and preparation of α -amino-acids.—See A., 1941, II, 243.

Kinetics of the ammonolysis of 2-chlorobenzothiazole by liquid ammonia. J. F. Lemons, R. C. Anderson, and G. W. Watt (*J. Amer. Chem. Soc.*, 1941, 63, 1953—1956).—The ammonolysis of 2-chlorobenzothiazole (I) by liquid NH₃ is a pseudo-unimol. reaction not appreciably catalysed by neutral salts or salts which are acid in liquid NH₃. The energy of activation is ~13,700 g.-cal. per mol. The mechanism of the reaction is discussed; it appears to involve a bimol., rate-determining reaction between (I) and NH₃. W. R. A.

Degradation of starch by β -amylase.—See A., 1941, II, 186.

Electron diffraction study of chemical reaction products of metals. Reaction between hydrochloric acid and sodium, calcium, beryllium, zinc, and aluminium. S. Yamaguchi (*Sci. Papers Inst. Phys. Chem. Res. Tokyo*, 1941, 33, 298—303).—When the reaction product is prepared as a thin film in a dry reaction the faster is the reaction velocity the larger are the crystals formed; in the wet reaction, the faster is the reaction velocity and the more hydrophilic is the compound formed the larger are the crystals. W. R. A.

Theory of thermal explosions. III. Thermal explosions in autocatalytic reactions. P. V. Melentev and O. M. Todes (*Acta Physicochim. U.R.S.S.*, 1941, 14, 27—52).—Mathematical. The theory already advanced (A., 1940, I, 28) is extended to cover the case of an autocatalytic reaction. F. J. G.

Antioxygenic effects of some nitroso-compounds. Inter-pretation of the effects from the point of view of resonance. Y. Tsuzuki and Y. Kimura (*Bull. Chem. Soc. Japan*, 1940, 15, 484).—The retarding effects of some NO-compounds on the autoxidation of PhCHO in air have been studied. Aliphatic compounds have little or no effect, but aromatic compounds have marked effects which for p -C₆H₄R·NO increase in the order (R =)H < Me < Cl < Br < I, suggesting that the effects are due to resonance. F. J. G.

Multimolecular solvolysis: catalysis of racemisation and hydrolysis of optically active α -phenylethyl halides by poly-halide metallic salts. N. T. Farinacci (*J. Amer. Chem. Soc.*, 1941, 63, 1799—1804).—The change in α with time of solutions in which several reactions proceed simultaneously is developed theoretically. The experimental data for (i) the solvolytic methoxylation at 100° and the methoxylation by OMe at 25° of CHMeBr·CO₂Me, and (ii) the solvolysis and racemisation of CHPhMeCl by HgCl₂, HgCl₃⁻, and EtOH are in accord with theory. The application of the theoretical considerations to other similar reaction systems is briefly discussed. W. R. A.

Simpler polypeptides. II. Kinetics of alcoholysis of poly-glycine esters. S. Glasstone and E. F. Hammel, jun. (*J. Amer. Chem. Soc.*, 1941, 63, 2003—2008; cf. A., 1941, I, 167).—Kinetics of the alcoholysis of di- (I), tri- (II), tetra- (III), penta- (IV), and hexa- (V) -glycine Et esters by boiling with 99.9% EtOH catalysed by 2.0M-HCl have been investigated. The sp. rate (V) of the first stage of the reaction, which is considered to involve the splitting off of one glycine residue (cf. A., 1932, 935), increases fourfold from (I) to (II), is approx. const. for (II), (III), and (IV), and increases for (V). The increase of V from (I) to (II) is attributed to electrostatic forces. The increase of V for (V) is considered to be due to a structural change under the experimental conditions. The fission of the esters is a true alcoholysis and not a hydrolysis followed by esterification. W. R. A.

Relative ease and mechanism of conversion of *syn*-aldoxime benzoates into nitriles in presence of pyridine and pyridinium chloride.—See A., 1941, II, 256.

Catalytic action of phenols in the isomerisation of camphene hydrochloride.—See A., 1941, II, 261.

Catalytic isomerisation of Δ^{α} -butene. G. H. Twigg (*Proc. Roy. Soc.*, 1941, A, 178, 106—117).— Δ^{α} -Butene isomerises to Δ^{β} -butene on a Ni catalyst in presence of H₂. By using D₂ the double bond migration has been examined simultaneously with the exchange and hydrogenation reactions. At 65° the kinetics of bond migration and of hydrogenation were identical; the reaction rates \propto the square root of the butene pressure and the H₂ pressure. The energies of activation of the three reactions were measured in the range 76—126°. The facts are in agreement with the theory that the catalytic exchange between olefines and D occurs through the formation of an associative complex. G. D. P.

Kinetics of the polymerisation of isoprene on sodium surfaces. J. L. Bolland (*Proc. Roy. Soc.*, 1941, A, 178, 24—42).—The reaction was studied at 60° and 25° for both liquid and vapour states. In the liquid, diffusion of the monomer to the catalytic surface is the rate-controlling factor, unless the Na surface is in the form of spheres of sufficiently small size. In the presence of PhMe the kinetics are consistent with the view that polymeric chains are initiated by formation of free radicals on the Na surface, the subsequent propagation occurring while the polymeride is still attached to the Na. Termination occurs by interaction with PhMe. In the absence of PhMe an alternative termination reaction requiring more activation energy comes into play. G. D. P.

Promoter effect of platinum chloride on Raney nickel. Hydrogenation of the nitrobenzoic acids and the nitrobenzene-aniline intermediates.—See A., 1941, II, 254.

Copper plating from ammonia bath.—See B., 1941, I, 412.

Electrolytic deposition of zinc.—See B., 1941, I, 412.

Electrolytic tin-plating of iron at high current densities with subsequent heating.—See B., 1941, I, 410.

Production of potassium permanganate. I. Anodic dissolution of ferromanganese in a diaphragm-free cell.—See B., 1941, I, 402.

Electrodeposition of nickel on iron and effect of colloids on nature of deposit.—See B., 1941, I, 410.

Volume and surface processes during the oxidation of nitrogen in a glow discharge. III. B. A. Kononova and N. I. Kobosev (*Acta Physicochim. U.R.S.S.*, 1940, 13, 193—218).—Previous investigations (cf. A., 1939, I, 619) have been extended to increased pressures (70—700 mm.). At these pressures the poisoning action of H₂O vapour decreases. This is consistent with the view that the poisoning action of H₂O vapour is a surface phenomenon which becomes relatively of less importance as the pressure increases and the reaction becomes almost wholly a vol. reaction. The poisoning action is also reduced at increased current strengths (33—150 ma.). C. R. H.

Production of sulphur monoxide by photochemical processes. A. Jakovleva and V. Kondratev (*Acta Physicochim. U.R.S.S.*, 1940, 13, 241—246).—At pressures <0.5 mm. the effective λ for the formation of S₂O₂ from SO₂ is <2000 Å. If COS containing SO₂ is used, S₂O₂ is formed at λ >2260 Å., although in absence of SO₂ no S₂O₂ is formed. From considerations of possible mechanisms and energy relations it is argued that the formation of SO is impossible under the experimental conditions and that S₂O₂ is the most probable carrier of the spectrum lines observed. C. R. H.

Chemical reactivity and light absorption. IV. N. R. Dhar, A. K. Bhattacharya, and S. P. Agarwal (*J. Indian Chem. Soc.*, 1940, 17, 675—680).—In the reactions between Cl₂ and H₂C₂O₄, between I and FeSO₄, Na tartrate, HCO₂Na, NH₂OH·HCl, COMe₂, and N₂H₄·H₂SO₄ respectively, between FeSO₄·(NH₄)₂SO₄ and AgNO₃, and between KMnO₄ and HCl the total light absorption is > that of the two reactants considered separately, and the increase in light absorption increases with higher concns. of the photosensitive reducing reactant. Increased light absorption and chemical reactivity are due to the weakening of the binding forces of a mol. in presence of a photosensitive reactant. C. R. H.

Photolysis of keten and structure of methylene. M. Burton, T. W. Davis, A. Gordon, and H. A. Taylor (*J. Amer. Chem. Soc.*, 1941, 63, 1956—1960).—The photochemical decomp. of

keten by $\lambda > 3000 \text{ \AA}$. has been investigated at temp. from 0° to 50° and pressures 50—200 mm. in the presence of various concns. of C_2H_4 and NO. The yield of C_2H_4 is decreased when the initial partial pressure of C_2H_4 is ~ 0.33 of the total pressure but is unaffected by an equiv. concn. of NO. The primary process is $\text{CH}_2\text{CO} + h\nu \rightarrow \text{CH}_2 + \text{CO}$ and the CH_2 combines exclusively with C_2H_4 . The average ratio $\text{CH}_2\text{CO} : \text{CO}$ is 1.2 and, therefore, CH_2CO appears to react with CH_2 . CH_2 may react with NO to give the free radical CH_2NO , which is unstable and decomposes to $\text{CH}_2 + \text{NO}$, or the CH_2NO may combine with CH_2 to give $\text{C}_2\text{H}_4 + \text{NO}$. CH_2 does not behave like a free radical with NO. CH_2 has either a free radical structure or a mol. (unpromoted electron) structure with heat of formation slightly $>$ that of a free radical.

W. R. A.

Photochemistry of aqueous solution of acetamide. D. H. Volman (*J. Amer. Chem. Soc.*, 1941, **63**, 2000—2002).—The photolysis of aq. NH_2Ac has been investigated; the products are NH_3 , AcOH , CO_2 , CO , CH_4 , and N_2 . The quantum yield of NH_3 increases with increasing concn. and temp. The relative rates of photolysis of NH_2Ac , $\text{EtCO}\cdot\text{NH}_2$, and $\text{Pr}^n\text{CO}\cdot\text{NH}_2$ are in the ratio 1 : 0.25 : 0.31.

W. R. A.

Theory of photosynthesis. J. Franck and K. F. Herzfeld (*J. Physical Chem.*, 1941, **45**, 978—1025).—Theories of photosynthesis hitherto published are criticised as not being in sufficient accord with facts. In a new theory which is outlined and developed mathematically the photosynthetic process is regarded as being a complicated interaction between light and dark reactions in which, in addition to chlorophyll, CO_2 , and H_2O , three different catalysts (affecting the initial process of CO_2 intake, the main photochemical process, and the liberation of O_2 from the peroxide), the acceptor mols. for CO_2 , the intermediates, and very probably proteins play a decisive rôle.

C. R. H.

Photometric determination of the rapidity of ergosterol transformation on irradiation with ultra-violet light.—See A., 1941, II, 250.

IX.—METHODS OF PREPARATION.

Thermal decomposition of alkali sulphates in presence of silica. J. A. Fialkov and S. D. Schargorodski (*Ber. Inst. Chem. Ukrain. Akad. Wiss.*, 1940, **7**, 415—428).—Alkali sulphate was mixed with SiO_2 (3 mols.) and heated for 1 hr. At 1000° 8% and at 1200° 63% of Li_2SO_4 , 3% and 20% of Na_2SO_4 , and 6% and 10% of K_2SO_4 , were decomposed. At 1100° 11% and at 1200° 12% of Rb_2SO_4 , and 8% and 13% of Cs_2SO_4 , were decomposed. The order of these % does not agree with that predicted by Nernst's theorem for the stability of the sulphates.

J. J. B.

Conditions of precipitation of calcium arsenate, and certain of its properties. M. T. Serebrennikova (*J. Appl. Chem. Russ.*, 1940, **13**, 1539—1544).—Addition of CaO to aq. Na_2AsO_4 results in production of solid solutions of CaO in $\text{Ca}_3(\text{AsO}_4)_2$, the Ca content of which rises with increase in the ratio $\text{CaO} : \text{As}_2\text{O}_5$, up to a certain limiting val. Above this, the ppt. consists of a mixture of solid solution and $\text{Ca}(\text{OH})_2$. These effects are obtained irrespective of the initial $[\text{As}_2\text{O}_5]$ of the solution. The ppts. are insol. in H_2O when the mol. ratio $\text{CaO} : \text{As}_2\text{O}_5$ is > 3.5 —5. Spraying tests show that the solid solutions were not harmful to foliage.

R. T.

Recovery of mercuric iodide and iodine from nesslerised solutions. G. W. Schimpff and R. E. Pottinger (*Ind. Eng. Chem. [Anal.]*, 1941, **13**, 337—338).— HgI_2 and I are pptd. by adding H_2SO_4 and $\text{Na}_2\text{Cr}_2\text{O}_7$ to the nesslerised solution. The free I is removed by distillation (apparatus and method described). The HgI_2 is collected, washed, and dried. Both substances are then ready for use in the prep. of Nessler-Folin reagent by Koch's method.

L. S. T.

Preparation of carbon disulphide from hydrogen sulphide and hydrocarbons.—See B., 1941, II, 289.

Derivatives of monosilane. II. Iodo-compounds. H. J. Emeleus, A. G. Maddock, and C. Reid (*J.C.S.*, 1941, 353—358).—*Mono- and di-iodosilane*, SiH_3I and SiH_2I_2 , have been prepared by the interaction of dry HI and SiH_4 in the presence of AlI_3 , and fractional distillation of the product, which also contains SiH_3I and SiI_4 . SiH_3I is a colourless refractive liquid, m.p. -35.0° , b.p. $45.4^\circ/760 \text{ mm.}$, with a pungent odour.

It crystallises in needle and prismatic forms. The v.p. has been measured at -23.5° to 42.8° and indicates that the latent heat of vaporisation at 30 — 40° is 7130 g.-cal. per g.-mol. Between 0.5° and 14.8° $d = 2.0718(1 - 0.00204\theta)$. At 15° $\sigma = 30.50$ dynes per cm., giving $[P] = 182.1$ (calc. val. 170). The vapour shows a continuous absorption in the ultra-violet region, with absorption limit in the region 2400—2520 \AA . and absorption max. at $< 2100 \text{ \AA}$. SiH_2I_2 has m.p. -1° , b.p. $149.5^\circ/760 \text{ mm.}$ The v.p. for the temp. range 0.1 — 140.2° is recorded and indicates that the latent heat of vaporisation at 83.4 — 93.4° is 8050 g.-cal. per g.-mol. Between 5.1° and 20.5° $d = 2.7943(1 - 0.00320\theta)$. At 15° $\sigma = 44.1$ dynes per cm., giving $[P] = 267$ (calc. val. 250). It shows continuous absorption beginning in the region 3530—2730 \AA . The action of ultra-violet light on SiH_2I_2 at 50° yields H_2 , SiH_3I , SiH_2I , SiI , and another solid product, probably an iodo-di- or tri-silane. SiH_3I is also decomposed in ultra-violet light at 50° , yielding an I-free solid, probably a polymeric Si hydride, and an oil, possibly a substituted higher silane. Neither SiH_3I nor SiH_2I_2 is spontaneously inflammable in air, but they burn with reddish flames. In moist air simultaneous hydrolysis and oxidation occur. SiH_3I vapour reacts with Hg in sunlight yielding HgI , SiH_4 , Si_2H_6 , and H_2 . The liquid, in the absence of sunlight, yields a white volatile cryst. solid, possibly $\text{HgI}\cdot\text{SiH}_3$, which decomposes into HgI and SiH_4 . SiH_3I reacts slowly with Zn yielding H_2 , SiH_4 , and a liquid, probably $\text{ZnI}\cdot\text{SiH}_3$. With Mg in diisomyl ether SiH_3I yields a dark solid and the Mg dissolves, probably forming $\text{MgI}\cdot\text{SiH}_3$. Liquid SiH_3I reacts explosively with AgCN yielding AgI and a brown polymeric solid, but when SiH_3I vapour is passed over AgCN at room temp. silyl cyanide SiH_3CN , m.p. 34° , is produced. With Na SiH_3I yields Si_2H_6 . Differences in the behaviour of SiH_3I and SiH_3Cl are attributed to the great difference in bond energies of the Si-Cl and Si-I linkages.

J. W. S.

Phosphorus-halogen compounds from phosphorus pentoxide and halides. Properties of phosphorus trifluoride and phosphorus oxyfluoride. G. Tarbutton, E. P. Egan, jun., and S. G. Frary (*J. Amer. Chem. Soc.*, 1941, **63**, 1782—1789).— P_2O_5 and CaF_2 react to give POF_3 as a volatile product but other compounds appear in the volatile fraction; PF_3 is produced by reduction of POF_3 by the Fe vessel, and HPO_2F_2 is formed by partial hydrolysis of POF_3 . No PF_5 was found. In the volatile fraction from the reactions between P_2O_5 and rock phosphate or fluorapatite at 700° the principal constituent was SiF_4 , but PF_3 , POF_3 , and CO_2 were also present. With CaCl_2 and with NaCl P_2O_5 reacts to give POCl_3 , PCl_5 , and HCl . The wt. of POCl_3 was 3—10 times the wt. of PCl_5 formed. The amount of HCl \propto the amount of H_2O in the charge. No PCl_5 was found but a trace of Cl_2 was detected. The reaction between P_2O_5 and a mixture of CaF_2 and NaCl has been studied at P:halogen ratios 2:3, 4:3, 5:3, and Cl:F ratios 1:1 and 3:2 at temp. between 350° and 600°. With P:halogen 2:3 the principal volatile product was POF_3 , but with the other ratios a mixture of PF_3 , POF_3 , POF_2Cl , POCl_2 , POCl_3 , and HCl was formed. At temp. $> 500^\circ$ POF_3 was the constituent present in largest amount. The components of volatile mixtures were separated by fractional distillation and analysed. M.p. and b.p. are given. The v.p. of PF_3 and POF_3 can be represented, respectively, by $\log p = -861.9/T + 7.9269$ and $-1984.7/T + 11.3755$ (solid), $-1207/T + 8.0524$. The heats of sublimation, fusion, and vaporisation of POF_3 are, respectively, 9150, 3600, and 5550 g.-cal. per g.-mol.; the heat of vaporisation of PF_3 is 3950 g.-cal. per g.-mol. *Disfluorophosphoric acid*, HPO_2F_2 , has been isolated.

W. R. A.

Complex chromi-selenates. P. C. Raychoudhury (*J. Indian Chem. Soc.*, 1941, **18**, 97—102).—Evaporation of a solution of green $\text{Cr}_2(\text{SeO}_4)_3 \cdot 13\text{H}_2\text{O}$ (I) (1 mol.) with H_2SeO_4 (1 mol.) followed by drying at 120° yields the green hygroscopic *chromiselenic acid* $\text{H}[\text{Cr}(\text{SeO}_4)_2]$. Evaporation of a solution of blue $\text{Cr}_2(\text{SeO}_4)_3 \cdot 17\text{H}_2\text{O}$ (II) (1 mol.) with H_2SeO_4 (3 mols.) yields $\text{H}_3[\text{Cr}(\text{SeO}_4)_3]$ (cf. Meyer, A., 1922, ii, 70). Evaporation in a vac. of a solution containing (II) (1 mol.) and H_2CrO_4 (1, 2, or 3 mols.) yields *chromiseleni-mono-, -di-, and -trichromic acids*, $\text{H}_2[\text{Cr}_2(\text{SeO}_4)_3(\text{CrO}_4)]$, $\text{H}_3[\text{Cr}_2(\text{SeO}_4)_3(\text{CrO}_4)_2]$, and $\text{H}_4[\text{Cr}_2(\text{SeO}_4)_3(\text{CrO}_4)_3]$, respectively. All are brown and hygroscopic. If K_2CrO_4 is used instead of H_2CrO_4 the three *K chromiselenichromates* are formed. Freshly prepared cold aq. solutions of these compounds give no ppt. with aq. NH_3 or with $\text{Ba}(\text{NO}_3)_2$, but on boiling ppts. are formed. Evaporation

of aq. solutions containing green $\text{Cr}_2(\text{SO}_4)_3$ (1 mol.) and (I) (3 mols.) or $\text{Cr}_2(\text{SO}_4)_3$ (3 mols.) and (I) (1 mol.) yields the green *Cr chromi-selenatosulphate* and *-sulphatoselenate*, $\text{Cr}_2[\text{Cr}_2(\text{SeO}_4)_3(\text{SO}_4)]_3$ and $\text{Cr}_2[\text{Cr}_2(\text{SO}_4)_3(\text{SeO}_4)]_3$, respectively. Evaporation of aq. solutions containing *Cr chromichromate* (III) (1 mol.) and (I) (1 mol.) or H_2CrO_4 (3 mols.) yields the dark red *Cr chromiselenatochromate* $\text{Cr}_2[\text{Cr}_2(\text{SeO}_4)_3(\text{CrO}_4)]_3$ and chocolate *Cr chromidichromate* $\text{Cr}[\text{Cr}(\text{Cr}_2\text{O}_7)_3(\text{H}_2\text{O})_3]_3\text{H}_2\text{O}$, respectively. J. W. S.

Compounds of salts of bivalent manganese with pyridine and ethylenediamine. O. E. Zvjagintzev and M. Tschkonja (*J. Gen. Chem. Russ.*, 1940, 10, 1647—1652).—The salts $2\text{MnF}_2 \cdot 2\text{NH}_4\text{F} \cdot \text{C}_5\text{H}_5\text{N}$; $5\text{MnF}_2 \cdot 3\text{en} \cdot 3\text{HF}$; $\text{MnCl}_2 \cdot \text{en} \cdot 2\text{HCl} \cdot \text{H}_2\text{O}$; $\text{Mn}(\text{NO}_3)_2 \cdot 8\text{en} \cdot 4\text{HNO}_3 \cdot 4\text{H}_2\text{O}$; $\text{Mn}_2\text{O}_3 \cdot 10\text{en} \cdot 4\text{H}_2\text{C}_2\text{O}_4$; and $\text{Mn}(\text{OAc})_2 \cdot \text{en} \cdot \text{AcOH}$ are described. R. T.

Composition of Prussian and Turnbull's blues. V. Rôle of hydrolysis and their compositions. A. K. Bhattacharya (*J. Indian Chem. Soc.*, 1941, 18, 81—84; cf. A., 1941, I, 374).—The CN:Fe ratio in both Prussian and Turnbull's blue decreases with decreasing concn. of the solutions from which they are pptd., tending to vals. of 2.37 and 2.5, respectively. When pptd. by mixing $\sim 0.125\text{M}$. solutions the compounds have identical composition with CN:Fe = 2.465. J. W. S.

Ammoniates of cobalt fluoride. M. S. Litvinov (*J. Gen. Chem. Russ.*, 1940, 10, 1490—1494).—Boiling aq. $[\text{Co}(\text{NH}_3)_6]\text{Cl}_2$ and AgF yield $[\text{Co}(\text{NH}_3)_5\text{F}]_2\text{F}_2$, whilst at room temp. the product is $[\text{Co}(\text{NH}_3)_5\text{ClF}]_2$, readily converted by aq. AgF at 100° into $[\text{Co}(\text{NH}_3)_5\text{H}_2\text{O}]_2\text{F}_2$. This with HF gives $[\text{Co}(\text{NH}_3)_5(\text{H}_2\text{O})_2\text{F}]_2\text{F}_2$, converted by H_2O at 100° into $[\text{Co}(\text{NH}_3)_5(\text{H}_2\text{O})_3]_2\text{F}_2$. The cobaltamine fluorides resemble the corresponding chlorides, but are in general more stable. R. T.

X.—ANALYSIS.

Tracer isotopes in analytical chemistry. J. F. Flagg and E. O. Wiig (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 341—345).—A review dealing with the prep. and separation of radioactive elements, measurement of the radiations, and applications to analysis. L. S. T.

Colorimetric determination of p_{H} in coloured or turbid solutions. J. V. Kariakin (*J. Appl. Chem. Russ.*, 1940, 13, 1713—1717).—Fixed proportions of indicator and of org. solvent are added to the solution, which is shaken, and the coloration of the non-aq. layer is compared with those of a series of standard buffer solutions similarly treated. The combinations suggested are: p_{H} 0—2.0, Me-yellow and *iso*- $\text{C}_6\text{H}_{11}\text{OH}$ (I); p_{H} 1—3, cresol-red and (I); p_{H} 3—5, thymol-blue and (I); p_{H} 4—6, bromophenol-blue and Bu^βOH ; p_{H} 6—9, bromocresol-purple and Bu^βOH ; p_{H} 8—10, rosolic acid and 1:4 (I)—EtOH; p_{H} 10—13, methylene-blue and pinene. The error is $p_{\text{H}} \sim 0.1$ —0.2. R. T.

Ascorbic acid as titrimetric standard. L. Rosenthaler (*Pharm. Acta Helv.*, 1940, 15, 213—216).—Ascorbic acid is a satisfactory alkalimetric and iodometric standard. It is unsuitable for use with AgNO_3 or KMnO_4 . E. H. S.

Quantitative spectroscopic analysis of soils.—See B., 1941, III, 194.

Determination of moisture in solid materials.—See B., 1941, I, 378.

Determination of moisture in gases.—See B., 1941, I, 379.

Determination of water in benzene.—See B., 1941, II, 245.

Determination of iodine in soil waters. P. A. Smirnov (*J. Appl. Chem. Russ.*, 1940, 13, 1718—1721).—To 500 ml. of H_2O are added 1% starch solution 60, 0.5N- NaNO_2 16, 4N- H_2SO_4 10 ml., and 2 g. of $\text{CO}(\text{NH}_2)_2$. After thorough stirring 10 g. of $\text{NH}_4\text{Fe}(\text{SO}_4)_2 \cdot 12\text{H}_2\text{O}$ are added, followed by NaHCO_3 to complete pptn. of Fe. The ppt. of $\text{Fe}(\text{OH})_3$ with co-pptd. starch and adsorbed I, is collected on the centrifuge, and the process is repeated with the centrifugate. A solution in 4N- H_2SO_4 of the combined ppts. is distilled for 20 min., and the I collecting in the receiver is titrated with 0.2N- $\text{Na}_2\text{S}_2\text{O}_3$. An empirical correction of 1 mg. is added to the result. R. T.

Determination of iodate ion in presence of cupric ion. P. L. Kapur and M. R. Verma (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 338).—Mixtures of KIO_3 and CuSO_4 can be titrated with

$\text{Na}_2\text{S}_2\text{O}_3$ (starch) after an excess of $\text{Na}_4\text{P}_2\text{O}_7$, AcOH, and KI have been added in this order. The Cu complex formed with $\text{P}_2\text{O}_7^{4-}$ is stable under the conditions given. Liberation of I from the KIO_3 and KI is slow, and several likely catalysts, e.g., NH_4 molybdate, failed to speed up the reaction. L. S. T.

[Determination of] fluorine. P. A. Clifford (*J. Assoc. Off. Agric. Chem.*, 1941, 24, 350—363).—The "positive perchlorate error" observed in Willard and Winter's method (A., 1933, 242) can be reduced to $< 1 \mu\text{g}$. F per 150 ml. of distillate by using all-glass apparatus and avoiding superheating of the sides of the flask. The remaining error is due to F, presumably from the glass of the still. H_2SO_4 is more effective than HClO_4 as a distilling acid, but recovery is incomplete even if > 150 c.c. are collected. The cause of the retention of F is unknown, but fuming the still with H_2SO_4 increases recovery. Methods are detailed. The indicator preferred is *p*- $\text{NO}_2\text{-C}_6\text{H}_4\text{-OH-EtOH}$, and a little $\text{NH}_4\text{OH.HCl}$ is used to discharge traces of Cl when HClO_4 is employed. Porcelain contributes small quantities of F to ash. Filtration through glass filters avoids possible contamination with HF from treated filter-paper. A. A. E.

Determination of sulphur in sulphur-bearing ores by combustion in a current of oxygen.—See B., 1941, I, 412.

Detection of nitrates and nitrites by means of amidol (2:4-diaminophenol hydrochloride). M. V. Darbinian (*J. Appl. Chem. Russ.*, 1940, 13, 1745—1746).—A 1% solution of amidol in dil. HCl is added to the solution under test; a red coloration appears in presence of $< 5 \text{ mg}$. NO_2 per l. When 1% amidol in conc. H_2SO_4 is added carefully to the solution, a red ring forms above the H_2SO_4 layer in presence of $< 50 \text{ mg}$. NO_3 per l. R. T.

Determination of ammoniacal and nitrate-nitrogen in decomposed plant material.—See A., 1941, III, 713.

Perchloric acid oxidation of organic phosphorus in lake waters. R. J. Robinson (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 465—466).—The H_2O , acidified with HClO_4 , is evaporated and the P determined colorimetrically as PO_4^{3-} using Denigès' method. Results comparable with those found using $\text{H}_2\text{SO}_4\text{-HNO}_3$ for oxidation are obtained, but the procedure is simpler. J. D. R.

Analysis of sodium meta-, pyro-, and ortho-phosphates. A. B. Gerber and F. T. Miles (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 406—412).—The method described previously (A., 1938, I, 582) is applied to the analysis of Na phosphates, and compared with other methods of analysis. It determines the amounts of P_2O_5 associated with 1, 2, or 3 Na_2O or H_2O , which are reported as meta-, pyro-, and ortho-phosphate, respectively, but does not distinguish between a polyphosphate and a mixture of equiv. amounts of meta- and pyrophosphate. Sources of discrepancies in using various methods of phosphate analysis are discussed. In methods where phosphate radicals are determined by pptn. with metallic ions consideration cannot be limited, as is common, to meta-, pyro-, and ortho-phosphates, but must be extended to the phosphate complexes or polyphosphates. L. S. T.

Determination of arsenic in foods contaminated by war gases.—See B., 1941, III, 211.

Rapid determination of arsenic in foodstuffs contaminated with lewisite.—See B., 1941, III, 211.

Determination of boron by means of quinalizarin. P. W. Maunsell (*New Zealand J. Sci. Tech.*, 1940, 22, B, 100—111).—A solution (1 c.c.) containing B ($\sim 0.002 \text{ mg}$.) was treated with 99.4% H_2SO_4 (9 c.c.) and quinalizarin (0.5 c.c.); 0.01 g. in 88.6% H_2SO_4 and set aside overnight over H_2SO_4 , and the red colour (mixed with blue) determined by comparison with a standard. The colour changes rapidly at first but reaches a const. val. after some hr. (cf. Smith, A., 1936, 42); rise in temp. does not affect the development of the colour. A slight increase in $[\text{H}_2\text{SO}_4]$ diminishes the amount of the red component, and vice versa. Atm. H_2O does not affect the colour development until the v.p. is 7.5 mm. of H_2O . Org. matter bleaches the blue colour but does not affect the red. C introduces neutral tints. A small excess of quinalizarin increases the red and blue components in the same ratio. When the B content is $> 0.004 \text{ mg}$., the accuracy of the method is greatly reduced. The method is applied to the determination of B in soils and plants. J. L. D.

Determination of carbon monoxide in combustion gases by means of iodine pentoxide.—See B., 1941, I, 388.

Evolution-volumetric method for [determining combined] carbon dioxide [in soaps].—See B., 1941, II, 310.

Application of electrotitration to analysis of soap.—See B., 1941, II, 310.

Rapid determination of potassium with hexanitrodiphenylamine (dipicrylamine). H. Sueda and M. Kaneko (*Bull. Chem. Soc. Japan*, 1941, 16, 137—139).—The ppt. after washing is dissolved in COME₂ and the solution directly titrated with standard acid, the end-point being indicated by the resulting colour change. The method is rapid and accurate to ~1%. F. L. U.

Qualitative analysis for cations, without the use of hydrogen sulphide. I. P. Vilgusevitch (*J. Appl. Chem. Russ.*, 1940, 13, 1747—1754).—An analytical procedure is proposed. R. T.

Detection of silver by means of ammonium persulphate and manganese sulphate. P. G. Popov (*J. Gen. Chem. Russ.*, 1940, 10, 1442).—5 ml. of 0.016% MnSO₄ in N-H₂SO₄ are added to 5 ml. of solution, the mixture is heated to 100°, 0.1 g. of (NH₄)₂S₂O₈ is added, and the coloration developing after 4 min. is compared with that given by a blank test. A rose-violet colour appears in presence of < 5 µg. Ag. R. T.

Titration of oxalate [and of calcium].—See A., 1941, II, 236.

Determination of blood-magnesium.—See A., 1941, III, 730.

Determination of zinc by precipitation as zinc anthranilate. Gravimetric semi-micro-method. C. W. Anderson (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 367—368).—Details of procedure for the determination of Zn as anthranilate in Zn-Sn alloys, enamel coatings, white metal alloys, and ZnCl₂ fluxes, and typical results obtained, are recorded. Small amounts of Zn⁺⁺ are separated from large amounts of Fe⁺⁺⁺ by a modified basic acetate method. L. S. T.

Determination of small amounts of zinc in plant materials: dithizone method.—See A., 1941, III, 713.

[Determination of] copper. C. A. Greenleaf (*J. Assoc. Off. Agric. Chem.*, 1941, 24, 337—348).—Procedure and collaborative data for the determination of Cu in presence of Ni, Co, Zn, Sn, and Bi in a sample simulating spinach ash, (a) by separation with H₂S in presence of Pb⁺⁺ as gatherer, and (b) by extraction with dithizone, followed by colorimetric determination with NET₃-CS₂-Na (I), are recorded. There was considerable variation in the quantity of Bi extracted in (b). In absence of Bi, Co, and Ni, the (I) method may be applied directly to a solution obtained by wet combustion or ashing. A. A. E.

Determination and separation of copper with benzotriazole. J. A. Curtiss (*Ind. Eng. Chem.*, 1941, 13, 349—351).—Benzotriazole (I) ppt. Cu⁺⁺, Fe⁺⁺, Ag⁺, Ni⁺⁺, Cd⁺⁺, Zn⁺⁺, and Co⁺⁺ from ammoniacal tartrate-OAc⁻ solutions. Pptn. of Cu is complete only between μ_{II} 7.0 and 8.5. In absence of these ions, Cu⁺⁺ can be pptd. directly and, after drying for 2—3 hr. at 135—140°, weighed as (C₆H₄N₃)₂Cu. 45 ml. of 2% aq. (I) are required to ppt. 0.01 g. of Cu⁺⁺, and 50 ml. for 0.018 g. of Cu⁺⁺, which is the max. amount of Cu⁺⁺ permissible for rapid and convenient handling of the voluminous ppt. 0.0002 g. of Cu⁺⁺ in 200 ml. of solution can be determined. Digestion times of 5 or 30 min. at 25° or 100° are equally effective in pptg. the Cu. In presence of the above ions, (I) is used for preliminary separation of Cu⁺⁺. The ppt. is then ignited to oxide, and the Cu⁺⁺ determined by a standard method, generally by means of KI and Na₂S₂O₃. (I) can be used in this way for the determination of Cu in cast Fe and steels; details of procedure are given. Advantages over pptn. of Cu as CuS are that an oxidising attack can be used, a clean separation from Mo^{VI}, Se^{IV}, Te^{IV}, Sb^V, and As^V is obtained, and ignition of the ppt. is more rapid, with less danger of fusion, than that of CuS. Separation of Cu by (I) is not practicable in presence of large amounts of Ni, Co, Ag, Cd, and Zn. Besides the group IIb metals mentioned above, Fe⁺⁺⁺, Sb⁺⁺⁺, Sn⁺⁺⁺, Cr⁺⁺⁺, CrO₄⁺⁺, and Al⁺⁺⁺ are not pptd. by (I) in ammoniacal tartrate-OAc⁻ solution. L. S. T.

Bromo-complexes for identification of metals and alkaloids. E. P. White (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 509—511).—Conditions for the use of bromo-metallic salts of alkaloids,

sparingly sol. in bromide solution, as micro-analytical tests for Hg, Cd, Bi, Sb, Pb, and Sn, or as tests for alkaloids of certain *tertiary* types are described. Such salts are often crystalline and characteristic in appearance, and photomicrographs of many are reproduced. Likely sources of interference are discussed and concn. limits are given for different alkaloids and metals. Mixtures have not been studied. A scheme for the systematic identification of certain alkaloids is presented. J. D. R.

Fractional detection of aluminium. I. M. Korenman (*J. Appl. Chem. Russ.*, 1940, 13, 1722—1723).—NH₄Cl and excess of aq. NH₃ are added to the solution, which is then boiled, and the ppt. is collected and washed with aq. NH₄Cl-NH₃, and then with conc. aq. NH₃. NH₄Cl and alizarin-red are added to the aq. NH₃ washings, and the solution is boiled. A rose-red coloration is obtained in presence of < 0.1 mg. Al. Other cations and anions do not interfere. R. T.

Use of silicomolybdic acid indicator before volumetric oxidation of iron. A. C. Titus and C. W. Sill (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 416—418).—In the method detailed and illustrated by test data, silicomolybdic acid indicator, which is reduced to Mo-blue by SnCl₂, replaces HgCl₂, since the blue colour disappears just before oxidation of Fe⁺⁺ begins. The vol. of standard K₂Cr₂O₇ used between this "blue end-point" and the appearance of the red colour of N-phenylanthranilic acid indicator is equiv. to the Fe being determined. The method is accurate to 1 in 1000. L. S. T.

Iodometric determination of ferric iron in presence of organic material. R. G. Parchomenko (*J. Appl. Chem. Russ.*, 1940, 13, 1740—1744).—KI is added to the solution, which should contain 2 mols. of HCl per Fe⁺⁺⁺, and the I liberated is titrated. A no. of org. substances (mannitol, tartaric acid, glycerol, sucrose, glucose, soil extracts) do not interfere. R. T.

Determination of neutral salt contents of chrome [tanning] liquors by conductometric analysis.—See B., 1941, II, 285.

Semi-quantitative determination of small amounts of tin, using "anthrazo-reagent" (1-p-dimethylaminobenzeneazo-anthraquinone). V. I. Kuznetsov and I. M. Bender (*J. Appl. Chem. Russ.*, 1940, 13, 1724—1731).—A drop of solution is placed on paper impregnated with aq. 1-p-dimethylaminobenzeneazoanthraquinone hydrochloride; a blue stain appears in presence of 0.01—0.05 mg. Sn^{IV} per ml. of solution. The intensity of coloration is compared with those given by a series of standard Sn^{IV} solutions. Certain cations interfere when their concns. are > the following: Zn, U, Mo I, Cd 0.5, Al 25 mg. per ml., whilst Sb and Te do not interfere when present as Sb^V and Te^{IV}. Nb interferes only when tartaric acid is present. R. T.

XI.—APPARATUS ETC.

M.p. apparatus. A. Yaussy and C. C. Kiplinger (*Science*, 1941, 93, 166).—In the apparatus described a triple-wall air-bath minimises heat losses and eliminates inflammable or corrosive bath liquids, the thermometer is enclosed entirely, no stirrer is required, and the thermometer bulb and melting capillary are partly surrounded by Hg. L. S. T.

Graphite heating baths. W. I. Harber (*Ind. Eng. Chem. [Anal.]*, 1941, 13, 429).—The flask is placed on a layer of powdered graphite (I) in a slightly larger Fe container, and then surrounded and tightly packed with (I). Heating is done by means of a Bunsen or Meeker burner. Fire risk is eliminated, and distillations can be carried out at high temp. L. S. T.

Thyration-controlled annealing furnace. L. Tarnopol (*Rev. Sci. Instr.*, 1941, 12, 367—368).—A temp. control circuit and a furnace are described and figured. The furnace may be used at temp. > 1000°, and the circuit will give continuous precision control better than ±0.03° for any long period required, e.g., several weeks, even if the supply fluctuates over a range of from 90 to 130 v. A. A. E.

Theory of thermal explosions. IV. Study of the loss of heat in closed vessels for the purpose of determining the explosion constants. O. M. Todes and B. N. Karandin (*Acta Physicochim. U.R.S.S.*, 1941, 14, 53—70).—When convection plays a part in the transfer of heat from a reacting gas to the walls of the vessel, purely mathematical treatment fails. Accordingly, the cooling of a hot gas has been studied experimentally, and an empirical equation connecting functions of

various parameters (size of vessel, conductivity, viscosity, etc.) is given. F. J. G.

Flame temperature. B. Lewis and G. von Elbe (*J. Appl. Physics*, 1940, **11**, 698—706).—Methods of determining flame temp. are reviewed. The theoretical flame temp., corresponding with complete statistical equilibrium in the burned gas, is distinguished from the experimental flame temp. measured by the gas law equation, and corresponding with equilibrium in the translational degrees of freedom. The two temp. can be compared by explosion experiments. For monat. gases, mixed with H₂ and O₂ and exploded, the experimental and theoretical temp. are identical, but for diat. gases the experimental temp. are > the theoretical. This is due to excitation lag in the internal degrees of freedom. The theory and technique of the line reversal method are described. The method gives the experimental flame temp. The determination of flame temp. by wires and thermocouples, and by the measurement of brightness and absorptivity in the infra-red, are discussed. The luminous, soot-forming flame has a temp. corresponding with the theoretical. The temp. difference between the soot particles and the surrounding gas is negligible. Methods of determining the temp. and emissivity of such flames are described. A. J. M.

Refractive index of matter in a cylindrical form. A. H. Pfund (*J. Opt. Soc. Amer.*, 1940, **30**, 410—412).—A simple method of determining the refractive index, n , of liquids is described. The apparatus consists of two coaxial cylindrical lenses formed either by a glass rod immersed in a test-tube containing the liquid under test, or by a tube containing the test liquid immersed in a larger vessel containing a standard liquid. An inclined wire is observed through the lens system and the slope of the central part of the image is measured. n may be determined with an accuracy of a few parts per thousand. The refractometer has no upper limit and may be used for liquids with any val. of n . O. D. S.

Cell for optical diffusion measurements on solutions. H. Neurath (*Science*, 1941, **93**, 431—432).—A diffusion cell of small vol., designed on the principle of the new Tiselius electrophoresis cell, is described and illustrated. It is suitable for diffusion measurements with solutions of proteins as well as of substances of low mol. wt. L. S. T.

Modified photon reflectometer for use with test-tubes. R. L. Libby (*Science*, 1941, **93**, 459—460). L. S. T.

Spectrophotometry of [light of] low intensity. A. A. Schischlovski (*Physical Trans. Ukrain. Acad. Sci.*, 1940, **9**, 19—27).—A new spectrophotometer which utilises 40% of the light energy as compared with 6% in the Koenig-Martens apparatus is described. J. J. B.

Rotary compensators with a very large measuring range. A. Ehringhaus (*Z. Krist.*, 1939, **102**, 85—111).—A modified form of a previous instrument (A., 1938, I, 417), consisting of two 10-mm. quartz plates, has a measuring range of 70 λ_D , or 198 λ_D with extra plates, with an accuracy of 0.7%. Its size demands a special microscope stand and an objective of very wide aperture. A second compensator of moderate size (range 133 λ_D , accuracy 0.1%) consists of two 1-mm. calcite plates. The relation between compensation and dispersion of double refraction, and the determination of the point of compensation in the absence of dark fringes, are considered in detail. A. J. E. W.

Rotating differential photo-electric photometer for precision work. J. T. MacGregor-Morris and A. G. Stainsby (*Proc. Physical Soc.*, 1941, **53**, 584—594).—Methods of photometry using rectifier type Se cells are discussed. The design and performance are described for a new instrument in which two cells in opposition are rotated. Fluctuations of ~ 1 sec. can be studied photometrically, and the candle power ratio of two sources of the same colour can be determined in a few sec. to within 1 in 500. N. M. B.

Thermoelectric effects in photometry. J. K. Berry (*Ind. Eng. Chem. [Anal.]*, 1941, **13**, 396—397).—Errors due to such effects and their elimination are discussed. L. S. T.

Photo-electric apparatus for detection of methane.—See B., 1941, II, 245.

Photo-electric temperature control. A. D. Compton, jun. (*Science*, 1941, **93**, 215—216).—In the arrangement described the advantages of a thyatron tube are used more fully by employing the phase-shift method of control, and by eliminat-

ing the make-and-break contact of a Hg-PhMe thermo-regulator. The column of Hg in this regulator interrupts a focussed beam of light, and the rise or fall of the Hg decreases or increases the amount of light falling on a photo-tube, and this, in turn, controls the amount of current flowing through the heating unit. The bath temp. is controlled thus to $\pm 0.001^\circ$ for 48 hr. L. S. T.

Photon theory of optical resolving power. B. P. Ramsay, E. L. Cleveland, and O. T. Koppius (*J. Opt. Soc. Amer.*, 1941, **31**, 296—300).—Arguments are presented for the existence of an inverse dependence of resolving power on the magnitude of the intensity observed in an optical system. L. J. J.

Electron lens type of β -ray spectrometer. C. M. Witcher (*Physical Rev.*, 1941, [ii], **60**, 32—42).—The instrument utilises the focussing action of the homogeneous magnetic field of a long solenoid. Theory of the action for a point source of β -rays and extension to an actual source of finite area are discussed, and design and tests of the instrument are described. Data for the β -ray spectra of Ra-E, ²³²P, and ¹⁹⁴Ir are reported. The forms of the distribution curves agree better with the Fermi than with the Konopinski-Uhlenbeck theory. N. M. B.

Production, properties, and applications to micro-analysis of arcs possessing large-area anode spots. E. W. Foster (*Proc. Physical Soc.*, 1941, **53**, 594—613).—Factors influencing the area of hot spots are discussed. Experiments are described in which an arc is struck in air at atm. pressure between a graphite cathode and a graphite anode in the form of a cup at the end of a thin pillar. The cup is filled with powdered graphite impregnated with one of several alkali and alkaline-earth salts. At first a localised spot appears at each electrode, but after a time t_s the anode spot extends rapidly over the powder surface. This stable condition is maintained for a period t_b , usually $> t_s$, until the salt is exhausted. t_s and t_b depend on the amount and nature of the salt, on the anode dimensions, and on the arc current. The relation between t_s and t_b and the other variables is shown graphically and a theory is proposed. A satisfactory general spectrographic system of quant. microchemical analysis for mineral matter is suggested and discussed. N. M. B.

Electronic relay. R. C. Hawes (*Science*, 1941, **93**, 24).—An improved relay for heat control is described (cf. A., 1940, I, 420). L. S. T.

Electronic relay for heat control. A. C. Hall and L. J. Heidt (*Science*, 1940, **92**, 612).—A method for avoiding chattering in the relay described previously (A., 1940, I, 420) is given. L. S. T.

Vacuum tube time-delay relay. E. J. Serfass (*Ind. Eng. Chem. [Anal.]*, 1941, **13**, 352—353).—The relay described is constructed from standard radio replacement parts. It can be operated from a.c. or d.c. power supply. L. S. T.

A.c.-powered p_H set. C. W. Goodwin (*Science*, 1940, **92**, 587—588).—An a.c.-powered current amplifier that has a high input impedance and does not fluctuate spontaneously is described for measurement of p_H . L. S. T.

Saturated calomel electrode. M. G. Banus (*Science*, 1941, **93**, 601—602).—The electrode described and illustrated avoids disturbance of the interfaces and contamination of the saturated KCl. It is especially suitable for electrometric titrations of acid-base or oxidation-reduction potentials. L. S. T.

Sintered-glass salt bridge. H. A. Laitinen (*Ind. Eng. Chem. [Anal.]*, 1941, **13**, 393).—The construction of a \perp -shaped salt bridge from Pyrex glass with sintered glass at the two feet is described. The bridge has a low electrical resistance, and eliminates siphon action. L. S. T.

Indicator electrodes made of mixtures of electrolytically conducting salts. E. M. Skobetz and G. A. Kleibs (*Ber. Inst. Chem. Ukrain. Akad. Wiss.*, 1940, **7**, 299—309, and *J. Gen. Chem. Russ.*, 1940, **10**, 1612—1620).—Electrodes were prepared by closing an end of a glass tube with a molten and solidified mixture of AgI with AgBr or Ag₂S; the salt mixture was fixed to the glass with picein. The tube was filled with a KCl or AgNO₃ solution, and a Ag|AgCl electrode inserted. The resistance of AgI-AgBr and AgI-Ag₂S mixtures is so small that the e.m.f. of the cells Ag|AgCl|aq. KCl or AgNO₃|salt mixture|an aq. solution|saturated Hg₂Cl₂ electrode can be determined using a galvanometer as the null-point de-

pector. The arrangement was tested for the titration of AgNO_3 with KBr , KI , or KCNS , for the titration of KI with AgNO_3 , etc. Mixtures of 1 part of AgI and 1 part of AgBr , and of 9 parts of AgI and 1 part of Ag_2S , are recommended. J. J. B.

Electrical bombardment of biological materials. II. **Electron tube for the production of homogeneous beams of cathode rays from 10 to 100 kv.** O. Morningstar, R. D. Evans, and C. P. Haskins (*Rev. Sci. Instr.*, 1941, 12, 358—362).—Apparatus for the irradiation of a target area of 36 sq. in. with electron beams of intensity 10^{-6} — 10^{-10} coulomb per sq. cm. and of energy 10—100 kv. is described and figured. The beam can be easily adjusted and scanned for homogeneity. A. A. E.

Insulated vacuum leads. D. F. Bleil and C. D. Hause (*Rev. Sci. Instr.*, 1941, 12, 369—370).—An insulated, vacuum-tight, and readily replaceable filament assembly for an all-metal gaseous magnetron is described and figured. The W filament, of any desired length, is attached to the W supports by winding fine Fe wire around the two and melting the Fe with a spot welder. A. A. E.

Electron microscope. H. E. Rhea (*Science*, 1941, 93, 357—358).—The instrument described works on a normal 110-v. power line, and is simple to operate. With it 150 photographs of prepared specimens can be taken in a day. L. S. T.

Quartz fibre balance. O. H. Lowry (*J. Biol. Chem.*, 1941, 140, 183—189).—A hollow quartz fibre, 20 cm. long, is mounted nearly horizontally with the free end 12—15 cm. above the fixed end, and placed in an air-tight metal cylinder with a glass lid. The object to be weighed is hung on the free end and the movement read with a cathetometer. The balance has a sensitivity of 0.03 μg . with a capacity of 200 μg . D. F. R.

Distilling column head. P. Arthur and C. L. Nickolls (*Ind. Eng. Chem.*, [Anal.], 1941, 13, 356—357).—A column head for use in the prep. of spectroscopically pure org. liquids is described and illustrated. L. S. T.

Arrangement for fractional distillation at low temperature.—See B., 1941, I, 378.

Apparatus for pressure filtration. E. A. Brown and N. Benotti (*Science*, 1941, 93, 23—24).—The apparatus described permits sterilisation of protein solutions by rapid and foamless Seitz filtration. L. S. T.

Apparatus for producing constant gas mixtures. R. A. Lewis and G. F. Koepf (*Science*, 1941, 93, 407—408).—Apparatus for making const. mixtures of atm. air and N_2 is described. Data illustrating performance are given. Const. composition is obtained despite fluctuations in rate of flow. L. S. T.

Glass stopcocks. M. Shepherd (*Nat. Bur. Stand.*, 1941, 9, Circ. 430, 10 pp.).—A discussion, embracing the design, construction, grinding, lubrication, and care of stopcocks, with particular reference to high-vac. technique. Examples are given of specially designed stopcocks, having multi-bore keys, which replace a no. of simple stopcocks, and thus considerably reduce the no. of operations in routine gas sampling and analysis. D. F. R.

Pressure-regulating apparatus for vacuum systems. F. M. Lewis (*Ind. Eng. Chem.* [Anal.], 1941, 13, 418).—Two types of apparatus which will maintain a desired pressure within ± 0.2 mm. in the range 5—100 mm. are described and illustrated. L. S. T.

Method of measuring contact angles. J. J. Bikerman (*Ind. Eng. Chem.* [Anal.], 1941, 13, 443—444).—The method described is based on the measurement of the ratio Δ_0^3/v , where Δ_0 is the diameter of the basis of the drop and v the vol. L. S. T.

S.I.L. viscosimeter. E. L. Ruh, R. W. Walker, and E. W. Dean (*Ind. Eng. Chem.* [Anal.], 1941, 13, 346—349).—Construction and operation of a glass viscosimeter of the long-capillary type are described. The apparatus has been used successfully in routine tests. L. S. T.

Laboratory circulating pump. H. M. Woodburn (*Ind. Eng. Chem.* [Anal.], 1941, 13, 356).—A centrifugal stirrer of Pyrex

tubing rotated in a closed, flat, circular tin can is described. It gives a pumping rate of 1.3 l. per min. through a horizontal line and 0.65 l. per min. when H_2O is lifted 60 cm.

L. S. T.
Automatic speed control for the air-driven ultracentrifuge. A. Rothen (*Rev. Sci. Instr.*, 1941, 12, 355—358).—By means of an automatic optical device, based on a stroboscopic principle, the speed of the centrifuge can be maintained const. to < 1 r.p. sec. A. A. E.

Continuous water remover. J. H. Thelin (*Ind. Eng. Chem.* [Anal.], 1941, 13, 405).—Apparatus for removing H_2O formed in org. reactions is described and illustrated. L. S. T.

Apparatus for detection of sulphur dioxide [in air].—See B., 1941, III, 220.

Apparatus for detection of carbon monoxide in mines.—See B., 1941, III, 220.

Comparison of methods for sampling lead fume.—See B., 1941, III, 246.

Automatic carbon disulphide recorder.—See B., 1941, III, 246.

Simple automatic indication of dangerous concentrations of hydrogen cyanide in air.—See B., 1941, III, 246.

XII.—LECTURE EXPERIMENTS AND HISTORICAL.

Newer views of Priestley and Lavoisier. (Sir) P. J. Hartog (*Ann. Sci.*, 1941, 5, 1—56).

XIII.—GEOCHEMISTRY.

Nitrogen in rain water. P. A. Roelofsen (*Natuurwetensch. Tijds. Ned.-Indië*, 1941, 101, 179—180).—The rainfall and N content of the rain (average 1.5 mg. per l.) for the years 1925—1940 at the Deli Experimental Station (Medan) are recorded. In 1939, 13% of the total N was present as NH_3 . The origin of this N and its relationship with the N content of the Deli river H_2O are discussed. S. C.

Isotopic composition of atmospheric precipitations. S. G. Demidenko (*Acta Physicochim. U.R.S.S.*, 1940, 13, 305—311).—Investigation of the isotopic composition of snow, ice, and rain formed under a variety of conditions has shown that snow and hoar-frost have a low D and a normal ^{18}O content, whereas moisture and rain have a normal isotopic composition, although a few rain samples showed an increased ^{18}O content. C. R. H.

Hydrothermal formation of clay minerals in the laboratory. II. F. H. Norton (*Amer. Min.*, 1941, 26, 1—17).—An extension of previous work (A., 1939, I, 345) in which reactions have been carried out on similar materials, but at higher pressures of CO_2 and H_2O vapour. The rate of conversion of albite is greatest at 300° and ~ 300 lb. per sq. in. initial pressure of CO_2 . At pressures > 500 lb. per sq. in., there is no conversion into the end-product, which may be montmorillonite (I) or beidellite (II) (*cf. loc. cit.*). The conversion curve of nephelinite into sericite (III) is large in area, but has well-defined limits of temp. and CO_2 -pressure. The reaction area for orthoclase is limited, and at high pressure there is no conversion into (III). The relative amounts of kaolinite (IV) and dickite (V) obtained from spodumene under different conditions are tabulated; (V) predominates at the lower temp., and (IV) at the higher. The conversion contours are not closed completely at high pressures. With anorthite, the end-product is not pyrophyllite (*cf. loc. cit.*) but (I) or (II). At 300° and 500 lb. per sq. in., leucite and scolecite give (III), lepidolite gives a slight conversion into quartz, beryl, pollucite, and (IV) are unchanged, analcite gives (IV), quartz, and (V). Minerals containing the largest % of alkali are the least stable. For some of the above minerals, the rate of conversion by stronger acids (dil. HCl , H_2SO_4 , and HF) is $<$ that with CO_2 . In all reactions, the end-products are similar to, but not identical in every respect with, the natural clay minerals. L. S. T.

Periods of coal formation represented in the British Coal Measures. A. E. Trueman (*Geol. Mag.*, 1941, 78, 71—76).—The zonal distribution of the more important coal in various coalfields is discussed in relation to periods of coal formation. L. S. T.

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