

# METALLURGICAL ABSTRACTS

(GENERAL AND NON-FERROUS)

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Part 13

## I.—PROPERTIES OF METALS

(Continued from pp. 553-568.)

**Refined Aluminium.** Robert Gadeau (*Metallurgist* (Suppt. to *Engineer*), 1936, 11, 94-96).—Summary of a paper presented to the Congrès Internationale des Mines, de la Métallurgie, et de la Géologie Appliquée, Paris. See *Met. Abs.*, this vol., pp. 365 and 497.—R. G.

**On the Softening and Recrystallization of Pure Aluminium.** — (*Aluminium*, 1935, 17, 575-576).—A review of recent work of Calvet and his collaborators; see *Met. Abs.*, this vol., pp. 453, 454.—A. R. P.

**\*Some Optical Observations on the Protective Films on Aluminium in Nitric, Chromic, and Sulphuric Acids.** L. Tronstad and T. Höverstad (*Trans. Faraday Soc.*, 1934, 30, 362-366).—The optical properties of natural films on aluminium were measured in various solutions and their change with time of immersion observed. Little change occurs in such films in chromic acid solutions with or without chloride; the films are not protective in concentrated sulphuric acid, and in concentrated nitric acid the protective films are alternately dissolved and re-formed. The mean thickness of natural films on aluminium is 100  $\mu$  or more than 10 times as thick as those on iron.—A. R. P.

**\*Light from [Burning] Aluminium and Aluminium-Magnesium [Alloy].** J. A. M. van Liempt and J. A. de Vriend (*Rec. trav. chim.*, 1935, 54, 239-244). —S. G.

**\*Investigations Relating to Electrophotophoresis Exhibited by Antimony.** Gisela Isser and Alfred Lustig (*Z. Physik*, 1935, 94, 760-769).—Uncharged submicroscopic particles subjected to an electric field in an intense beam of light are found to move either in the direction of, or against, the field. This is the phenomenon of electrophotophoresis, which is here investigated in considerable detail for particles of antimony. Experimental results are not interpretable in terms of a theory which considers the particles to be surrounded by a cloud of ions.—J. S. G. T.

**Plasticity of Bismuth Due to Occluded Gas.** W. F. Berg (*Nature*, 1934, 133, 831).—Anomalous results obtained by Georgieff and Schmid (*J. Inst. Metals*, 1926, 35, 461) and by Gough and Cox (*J. Inst. Metals*, 1932, 48, 227) relating to the ductile properties of bismuth crystals are explained by assuming that the crystals used by G. and S. contained a certain amount of the gas used in cooling the crystals, which were prepared by the Czochralski method; G. and C. prepared their crystals by the Bridgman method. Experiments confirming the assumption that the content of gas is responsible for the slipping of a suitably-oriented bismuth crystal under tension are briefly described.—J. T.

**Plasticity of Bismuth.** W. F. Berg and L. Sandler. E. N. da C. Andrade (*Nature*, 1935, 136, 915).—B. and S. refer to discrepancies existing in the literature relating to the plasticity of bismuth. Andrade and Roscoe's method has been used to grow bismuth crystals *in vacuo* in various gases. Crystals grown *in vacuo* showed behaviour at variance with results obtained by Andrade and Roscoe. Gas content of the crystals appears to have little effect on the plasticity. The hardness of bismuth crystals prepared by Bridgman's method is probably another example of strain-hardening. A. replies, remarking that

\* Denotes a paper describing the results of original research.

† Denotes a first-class critical review.

he has been unsuccessful in conveying to B. the significance of A. and R.'s work on bismuth.—J. S. G. T.

**\*X-Ray Determination of the Thermal Coefficient of Expansion of Cadmium.** G. F. Kossolapov and A. K. Trapesnikov (*Zhurnal Eksperimental'noy i Teoreticheskoy Fiziki* (J. *Exper. and Theoret. Physics*), 1935, 5, (8), 729-743).—[In Russian.] Determination of the linear coeff. of expansion perpendicular to the main axis ( $\alpha_1$ ) and parallel thereto ( $\alpha_2$ ) by the X-ray method of Sachs and Weerts gave the following values between 26° and 189° C.:  $\alpha_1 = 1.7-2.2 \times 10^{-5}$  and  $\alpha_2 = 4.8 \times 10^{-5}$ .—N. A.

**\*Production of Very Low Temperatures by the Magnetic Method: Superconductivity of Cadmium.** N. Kúrti and F. Simon (*Nature*, 1934, 133, 907-908).—Particulars of experiments for the production of very low temperatures by adiabatic diamagnetization of manganese ammonium sulphate and other substances are briefly referred to. Cadmium is found to become superconducting, with a transition temperature at about 0.6° K.—J. S. G. T.

**\*Magnetic Properties of Solutions of Cadmium in Molten Cadmium Chloride and of Molten Calomel.** J. Farquharson and E. Heymann (*Trans. Faraday Soc.*, 1935, 31, 1004-1010).—Solutions of cadmium in cadmium chloride both in the solid and liquid states are diamagnetic and hence do not contain the subchloride  $\text{CdCl}$ ; they may contain  $\text{Cd}_2\text{Cl}_2$ , although it is more probable that the solutions contain solvated cadmium atoms.—A. R. P.

**\*Properties of Sublimed Calcium.** Paul Bastien (*Compt. rend.*, 1934, 199, 577-579).—Cf. *Met. Abs.*, this vol. pp. 413, 497. The properties of calcium sublimed by the Chaudron-Herenguel process, cast under argon, and of 99.3% purity (Ca(s)) are compared with those of two specimens of industrial calcium of 98.6% purity (Ca(A)) and 93% (Ca(B)). The coeff. of expansion between 20°-100° C. was  $25.2 \times 10^{-6}$ . The hardness was Ca(s), 13; Ca(A), 14; and Ca(B), 26. The density at 20° C. was  $1.542 \pm 0.005$ . The tensile strengths were: Ca(s), 4.4; Ca(A), 5.1; Ca(B), 2.8 kg./mm.<sup>2</sup>; elastic limits: Ca(s), 1.03; Ca(A), 2.2; Ca(B), very small; elongations: Ca(s), 53%; Ca(A), 30.5%; Ca(B), very small. The sublimed calcium was drawn to a wire between 420° and 460° C.; its hardness was 17 and elongation > 60%. The losses in weight in 1% alcoholic solution of hydrochloric acid were: Ca(s), 116; Ca(A), 147; Ca(B), 120 mg./cm.<sup>2</sup>. The more rapid corrosion of Ca(A) than Ca(B) was due to the fact that the impurities in the former are chiefly silicon and iron not in solid solution, those of Ca(B) being chiefly calcium chloride and lime. The rate of attack of sublimed calcium in hydrochloric, nitric, and sulphuric acids, measured by gas evolution for various dilutions of from 0-100%, is shown graphically.—J. H. W.

**\*Solubility of Oxygen in Solid Cobalt and the Upper Transformation Point of the Metal.** A. U. Seybolt and C. H. Mathewson (*Trans. Amer. Inst. Min. Met. Eng.*, 1935, 117, 156-172).—See *Met. Abs.*, this vol., p. 555.—S. G.

**\*Plasticity of Copper in Torsion.** V. D. Kuznetsov and V. A. Semenzov (*Zhurnal Eksperimental'noy i Teoreticheskoy Fiziki* (J. *Exper. and Theoret. Physics*), 1935, 5, (4), 343-351).—[In Russian.] The elastic limit of polycrystalline copper in stationary torsion is proportional to the applied torque, and the internal coeff. of friction  $\eta$ , calculated by taking into account the elastic limit and assuming that flow is caused not by the total effort applied but by the difference between this and the elastic limit, is a constant at all the stresses investigated. At 5° C.  $\eta = 1.4 \times 10^{14}$  grm./cm./second. With a constant torsion moment a gradual strengthening takes place and the elastic limit is increased.—N. A.

**\*The Heats of Adsorption of Hydrogen and Carbon Monoxide on Copper.** Ralph A. Beebe (*Trans. Faraday Soc.*, 1932, 28, 761-765).—Adsorption of carbon monoxide on copper granules is not uniform in its early stages, but

occurs in successive layers; the later stages and the adsorption of hydrogen are, however, uniform.—A. R. P.

**\*The Thickness of a Surface Film of Copper.** M. L. Nichols (*J. Amer. Chem. Soc.*, 1935, 57, 267–269).—If copper and platinum plates joined by an external wire are immersed in copper sulphate solution the platinum gradually becomes covered with a film of copper, which grows in thickness until it is thick enough to behave electrochemically as the massive metal; at the same time the potential between the plates decreases from 0.2649 v. practically to zero (to 0.0056 v. in 46 hrs.). This film is  $0.39 \times 10^{-6}$  mm. thick, a value only half as great as that found for the surface film of copper by Oberbeck (*Ann. Physik*, 1887, [iii], 31, 337).—A. R. P.

**The Corner Metals of Electrical Distribution: Copper, Aluminium, and Lead.** F. J. Brisoe (*Proc. Chem. Eng. Group*, 1933, 15, 55–59; discussion, 59–60).—See *Met. Abs.* (*J. Inst. Metals*), 1933, 53, 338.—S. G.

**A Correlation of the Tensile Strength and Electrical Conductivity of Hard-Drawn Copper Wire with Preferred Orientation.**—I–III. Roy Ward Drier (*Wire and Wire Products*, 1935, 10, 137–140, 183–190, 230–235, 248).—Cf. *J. Inst. Metals*, 1930, 43, 402. After brief references to wire-drawing in antiquity, modern developments are reviewed with special reference to technique in drawing copper wire. The grain-size of wire-bars has no influence on the quality of the wire produced from them. Vertically cast bars give wire with lower tensile strength and higher conductivity and elongation than bars cast horizontally; these differences may be connected with variations in oxygen content. Suggestions have been made for eliminating the casting, reheating, and rolling of wire-bars; in a method proposed by Kohlhaas, now in the experimental stage, copper is tapped from the furnace into grooves in a revolving horizontal plate. Wire drawn from a rod so produced fulfilled all A.S.T.M. specifications, and this procedure promises great results. Normal rod-rolling from re-heated bars is now so standardized as to lead to few defects. Pickling and continuous and single-block wire-drawing through cast iron, steel, tungsten or tantalum carbide, and diamond dies are briefly reviewed. The structural changes observed by X-rays and micrographic examination are correlated with electrical conductivity and tensile strength. Increase in hardness and tensile strength by cold-drawing are due not only to the effects of small-grain slip interference but also to unit cell orientation and to the probable presence of a phase in the amorphous (crystal fragmental) condition. Cold-drawing causes a definite type of preferred orientation of unit cells in the core of the wire in which the 111 and 100 planes are in positions which militate against optimum ease of deformation. Deformation by shear occurs most readily when the planes of easiest slip are at  $45^\circ$  to the direction of the deforming force, but the orientation of the core of hard-drawn wires causes this angle to differ widely from the optimum and, since it places the most densely populated atomic planes direct across the path of electronic drift, it also reduces the conductivity. Wires drawn entirely in one direction have a higher electrical conductivity than similar wires in which the direction of drawing has been reversed although the tensile strength is the same. References are given to the literature.—A. R. P.

**\*Observations on the Rare Earths.**—XLIII. I.—The Atomic Weight of Europium. II.—The Specific Gravity of Europium Chloride. E. L. Meyers with B. S. Hopkins (*J. Amer. Chem. Soc.*, 1935, 57, 241–243).—The atomic weight of europium is found to be  $152.30 \pm 0.018$ .—L. A. O.

**\*Optical Constants of Rhenium and Gallium for Wave-Lengths  $\lambda = 589$  m $\mu$  and  $\lambda = 438$  m $\mu$ .** Herbert Lange (*Z. Physik*, 1935, 94, 650–654).—Values of the optical constants, viz. refractive index, absorption and reflection coeffs. of rhenium (surfaces treated with emery, filed, and polished with chalk) and



gallium for wave-lengths 589 m $\mu$  and 436 m $\mu$  are given. Values obtained for mercury are also tabulated.—J. S. G. T.

**\*Note on the Failure of a Gold Fuse in Contact with Nickel-Chromium Alloy.** M. C. Caplan (*J. Inst. Metals*, 1935, 57, 197–198).—The failure of a gold safety fuse to operate at the correct temperature was found to be due to diffusion taking place between the gold link and the nickel-chromium connections at 950°–1000° C. An alloy of lower melting point is formed which offers little resistance to oxidation, and finally the gold link becomes disintegrated and converted into a cindery residue.—M. C. C.

**The Properties and Uses of Lead.** R. S. Russell (*Modern Eng.*, 1935, 9, 381–383, 393, 435–436).—The properties which govern long life in service, viz. fatigue limit, creep rate, grain-size, rate of recrystallization after cold-work, and corrosion-resistance, are reviewed with regard to recent research by R. and others. Fatigue failures are intergranular: the fatigue limit is reduced considerably by increase of temperature and by corrosion. The creep rate is markedly affected by small amounts of impurities and by precipitation effects caused by heat-treatment. The larger the grain-size, the less is the tendency to creep. Abnormally large grain-size is not thought to play any important part in failures of lead. Short-time corrosion tests are condemned and tests of at least 3 months' duration are required to judge the quality of lead. Copper, silver, and nickel increase, whilst antimony and bismuth decrease, corrosion-resistance.—H. W. G. H.

**\*Making and Testing Single Crystals of Lead.** B. B. Betty (*Proc. Amer. Soc. Test. Mat.*, 1935, 35, (II), 193–200; discussion, 201–203).—See *Met. Abs.*, this vol., p. 333.—S. G.

**\*Note on the Effect of Interrupted Straining on the Elongation of Lead.** J. C. Chaston (*J. Inst. Metals*, 1935, 57, 109–114; discussion, 114–119).—It was found that by interrupting a tensile test on commercially pure lead at intervals, during which the specimen is allowed to rest for a short time free from stress, abnormally high values of elongation are produced. These may be as much as 5 times those obtained in a normal tensile test. The influence on the elongation of the duration of the rest period, the rate of straining, the amount of elongation between successive rest periods, and the grain-size were studied by tests on extruded cable-sheath samples. Abnormal elongations are not produced by interrupted straining on "hardened" lead alloys at room temperature, but it is suggested that such effects may be obtained in these and any other metals and alloys if they are tested above their recrystallization temperatures. The observations recorded may thus have a bearing in connection with high-temperature metallurgical research.—J. C. C.

**\*Plasticity of Lead by Slipping.** V. D. Kuznetzov (*Zhurnal Eksperimentalnoy i Teoreticheskoy Fiziki* (*J. Exper. and Theoret. Physics*), 1935, 5, (2), 192–201).—[In Russian.] The plasticity of lead at room temperatures was studied by the method of double slip. It cannot be calculated, as in the case of liquid bodies, from the coeff. of internal friction, even if the elastic limit is taken into account. With a static flow of lead, the shear stress is constant and independent of the velocity. The shear stress is a characteristic of plasticity.—N. A.

**On the Development of Longitudinal Cracks in Cable-Sheathing and Other Cable Defects not Hitherto Described in the Literature.** Otto Haehnel (*Teleg. u. Fernsprech-Tech.*, 1935, 24, 179–182).—A detailed consideration of cable-sheath failures which are due to faults in manufacture. Longitudinal cracks frequently appear in the seam of the sheath (*Pressnaht*), which is generally present in commercial practice. No difference is found between the behaviour of different grades of lead, but lead hardened by alloying is less prone to longitudinal cracking. The observed phenomena are discussed and causes and remedies suggested.—C. E. H.

**Dependence of Magnetic Induction on the Magnetic Field in Superconducting Lead.** G. N. Rjabinin and L. W. Shubnikow (*Nature*, 1934, 134, 286–287).—Superconductivity is destroyed by a magnetic field, the critical field  $H_k$  depending on temperature. In the vicinity of  $H_k$  a sudden change occurs in the induction,  $B$ , with increasing as well as decreasing field-strength. This does not agree with the former concept of a superconductor, in which, when the field strength is decreased, the induction should be maintained constant by induced persistent currents. At  $H = 0$  the persistent currents give rise to a residuary magnetic moment in a superconductor.—J. S. G. T.

**Magnetic Induction in a Superconducting Lead Crystal.** G. N. Rjabinin and L. W. Shubnikow (*Nature*, 1935, 135, 109).—Magnetic hysteresis exhibited by lead single crystals at 4.24° K. is referred to. Destruction of superconductivity occurs in almost the same way in single crystals as in polycrystalline lead. The appearance of superconductivity is found to be different for single crystals and polycrystalline rods. All states of a superconductor with an induction differing from zero are considered to be unstable. Results confirm the concept of two phases, an ordinary and a superconducting phase with an induction equal to zero; transition from the superconducting to the ordinary phase occurs rapidly, whereas the reverse transition takes place more slowly.

—J. S. G. T.

**\*The Superconductivity of Thin Metallic Films [Lead].** A. D. Misener and J. O. Wilhelm (*Trans. Roy. Soc. Canada*, 1935, [iii], 29, (Sect. III), 5–11).—In an investigation of the superconductivity of thin films of tin (*Met. Abs.*, this vol., p. 277) it was found that the transition temperature was a function of the film thickness and that there was apparently a lower limit of thickness below which the films were not superconducting. Results obtained with thin films of lead now confirm the results found with tin, so that these latter results are not associated with the known existence of a non-superconducting allotrope of tin. Lead films show a rapid decrease of the transition temperature as the thickness is decreased below  $9 \times 10^{-5}$  cm. As in the case of tin films, the effect of current strength on the transition temperature is not in accordance with Silsbee's hypothesis.—J. S. G. T.

**\*The Atomic Weights of Several Radiogenic Leads.** Gregory P. Baxter and Chester M. Alter (*J. Amer. Chem. Soc.*, 1935, 57, 467–471).—The atomic weight of uranium lead is found to be at least as low as 206.00 and does not vary systematically with the age of the mineral source. The atomic weight of lead from various sources is investigated and is found to be between 205.93 (the lowest value) and 207.21 (the highest value).—L. A. O.

**\*The Rate of Solution of Magnesium in Acids.** Martin Kilpatrick and J. Henry Rushton (*J. Physical Chem.*, 1934, 38, 269–306).—Rates of solution of magnesium in aqueous solutions of hydrochloric, perchloric, benzene-sulphonic, sulphuric, acetic, chloracetic, dichloroacetic, formic, glycollic, citric, tartaric, and mixed acids were determined. The reaction rates are compared with those for zinc. The results can be interpreted in terms of a modified diffusion theory taking into account the water reaction.—J. S. G. T.

**\*Photoelectric Properties of Pure and Gas-Contaminated Magnesium.** R. J. Cashman and W. S. Huxford (*Phys. Rev.*, 1935, [ii], 48, 734–741).—See *Met. Abs.*, this vol., p. 557.—J. S. G. T.

**\*The Wiedemann-Franz Number of  $\beta$ -Manganese at  $-190^\circ$  C.** H. Reddemann (*Ann. Physik*, 1935, [v], 22, 28–30).—S. G.

**\*The Surface Tension of Mercury in a Silica Apparatus.** R. S. Burdon (*Trans. Faraday Soc.*, 1932, 28, 866–876).—A value of 488 dynes/cm. was found *in vacuo* and for a freshly formed drop in air. This value decreases almost linearly up to  $230^\circ$  C. by 0.23 dyne/ $^\circ$  C. The effect of gas adsorption on the surface tension of mercury is discussed.—A. R. P.

**\*The Thickness of Adsorbed Films on Mercury.** H. Cassel (*Trans. Faraday Soc.*, 1932, 28, 177-179).—The surface density of carbon tetrachloride adsorbed on mercury at 11° C. corresponds with a monomolecular film when the first layer is saturated. Adsorption follows Henry's law over a wide range.

—A. R. P.

**\*The Photochemical Reaction of Mercury with Oxygen.** J. M. Frank (*Acta Physicochimica U.R.S.S.*, 1935, 1, 833-854).—[In German.] The reaction between mercury and oxygen, excited by the incidence of short-wave radiation, is investigated, and the mechanism of the reaction is discussed.—J. S. G. T.

**\*Absorption of Hydrogen by Nickel.** J. Smittenberg (*Nature*, 1934, 133, 872).—Between 200° and 650° C. there is no appreciable adsorption of hydrogen by nickel, but an appreciable absorption (homogeneous solution) occurs. The amount of absorbed hydrogen at a constant temperature is proportional to the square root of the pressure; at constant pressure the dependence of the absorption,  $a$ , on temperature,  $T$ , is given by  $\log a = A - B/T$ . The heat of absorption, calculated from this isobar, is a little less than  $-3$  k. cal./gram. mol. of hydrogen.—J. S. G. T.

**\*A Magnetic Effect on Pirani Gauges using Nickel Wires.** Edwin McMillan (*Nature*, 1934, 133, 831-832).—The anomalous behaviour of a Pirani gauge for the measurement of low pressures, and probably attributable to the existence of a temperature gradient between the centre and ends of the wires, and being associated perhaps with a change of the Thomson coeff. of the wires, produced by a magnetic field due to an electromagnet near the gauge, is briefly referred to.—J. S. G. T.

**\*Gyromagnetic Effect for a Ferromagnetic Substance above Its Curie Point [Nickel].** W. Sucksmith (*Nature*, 1934, 134, 936).—Measurements of the gyromagnetic effect,  $g$ , in the case of 3 alloys of nickel and copper containing about 56.5% nickel and having respective Curie points at  $-14^{\circ}$  C.,  $-9^{\circ}$  C., and  $-2^{\circ}$  C., indicate that the value of  $g$  is 2.0 within experimental error. This indicates that the paramagnetism of nickel is due to spin alone.—J. S. G. T.

**\*Ferromagnetic Transformation and Catalytic Activity [Nickel].** J. Arvid Hedvall, R. Hedin, and O. Persson (*Z. physikal. Chem.*, 1934, [B], 27, 196-208).—Cf. *Met. Abs.*, 1934, 1, 548. The catalytic influence of nickel on the reaction  $N_2O = N_2 + O$  is shown to undergo a sudden change in the neighbourhood of the Curie point.—J. S. G. T.

**\*On Palladium-Hydrogen.** William Krause and Louis Kahlenberg (*Trans. Electrochem. Soc.*, 1935, 68, 449-469; discussion, 469-470).—See *Met. Abs.*, this vol., p. 499.—S. G.

**\*Properties of the Platinum Metals. I.—Strength and Annealing Characteristics of Platinum, Palladium, and Several of Their Commercial Alloys.** E. M. Wise and J. T. Eash (*Trans. Amer. Inst. Min. Met. Eng.*, 1935, 117, 313-324; discussion, 324-328).—See *Met. Abs.*, this vol., p. 140.—S. G.

**\*The Kinetics of Heat Adsorption of Oxygen on Platinum.** E. B. Maxted and N. J. Hassid (*Trans. Faraday Soc.*, 1933, 29, 698-702).—The heat of adsorption of oxygen on platinum black remains constant until the rate of adsorption becomes very small. At the beginning of adsorption the adsorption concentration depends on the oxygen pressure, but in the later stages it varies as  $kt^n$ , where  $t$  is the time and  $k$  and  $n$  are constants.—A. R. P.

**\*The Adsorption of Oxygen and Hydrogen on Massive Platinum.** Hans Reischauer (*Z. physikal. Chem.*, 1934, [B], 26, 399-412; *C. Abs.*, 1935, 29, 21).—Between 20° and 700° C. and below pressures of 0.05 mm., hydrogen is not appreciably adsorbed on platinum. With oxygen there is little adsorption at room temperature. Adsorption begins at 120° C. while at 250° C. it is complete in a few minutes. Further increase in temperature has no effect until 400° C. is reached, when adsorption begins again. These two kinds of adsorption correspond to different heats of activation. The fraction of the platinum



surface that is covered depends on the previous treatment of the metal, but the total amount of oxygen adsorbed is constant and is about 5 layers thick. The rate of adsorption is nearly independent of pressure. This is explained by assuming that part of the platinum surface is composed of active atoms that aid the adsorption. A very high rate is observed for freshly outgassed platinum in the process with the lower heat of activation, but after several experiments the rate decreases. The oxygen adsorbed at the higher rate is very reactive with hydrogen, but whether the active platinum atoms in this case are identical with the ones referred to above cannot be decided.—S. G.

**Kinetics of the Reaction Between Carbon Dioxide and Hydrogen on Platinum from the Standpoint of the Adsorption Theory of Catalysis.** M. Temkin and E. Michailova (*Acta Physicochimica U.R.S.S.*, 1935, 2, 9-32).—[In English.] Previous results relating to catalysis of the reaction  $\text{CO}_2 + \text{H}_2 = \text{CO} + \text{H}_2\text{O}$  are considered to have been vitiated owing to the presence of catalytic poisons. Sources of poisoning being removed, the reaction rate agrees with the equation  $dp_{\text{CO}}/dt = k_1 p_{\text{H}_2} / (k_2 p_{\text{H}_2} + p_{\text{CO}})$ . The reaction rate is determined primarily by the rate of evaporation of carbon monoxide from the surface.—J. S. G. T.

**\*Heterogeneous-Homogeneous Catalysis.  $\text{H}_2 + \text{O}_2$  in the Presence of Platinum.** M. W. Poljakow, P. M. Stadnik, and A. T. Elkenbard (*Acta Physicochimica U.R.S.S.*, 1935, 1, 817-820).—[In German.] The mechanism of the catalysis of the reaction  $\text{H}_2 + \text{O}_2 = \text{H}_2\text{O}_2$  by platinum is investigated.—J. S. G. T.

**\*The Atomic Weight of Rubidium.** E. H. Archibald, J. Gilbert Hooley, and Norman W. F. Phillips (*Trans. Roy. Soc. Canada*, 1935, [iii], 29, (Sect. III), 155-162).—A value of 85.482 is found, chemically; this is somewhat higher than the accepted value, 85.44.—J. S. G. T.

**\*Anomalous Diamagnetism of Selenium.** S. S. Dharmati (*Nature*, 1934, 134, 497).—The diamagnetism of selenium is found to increase as the fineness of powdering is increased and at a certain stage the substance becomes paramagnetic, the paramagnetic value increasing on further powdering of the substance. Colloidal selenium is more paramagnetic than any of the powdered samples. The paramagnetism persists when the powdered samples are washed with absolute alcohol.—J. S. G. T.

**\*Photoelectric Effect in a Film of Silver Deposited on Nickel.** N. Fedeneff (*Physikal. Z. Sowjetunion*, 1935, 7, 58-65).—[In French.] It is shown experimentally that the energy of emission of photo-electrons emitted from a film of silver deposited on nickel increases initially with increase of thickness of the silver film, attains its maximum value at a thickness corresponding approximately to a monomolecular layer, and thereafter to the value corresponding to silver.—J. S. G. T.

**[Electrical] Conductivity of Tellurium.** C. H. Cartwright and M. Haberfeld (*Nature*, 1934, 134, 287-288).—The decrease of electrical resistance of tellurium due to the addition of bismuth, copper, or antimony is illustrated. The addition of 0.2% antimony or bismuth caused the electrical conductivity of tellurium to increase about 100-fold and the temperature coeff. of resistance to change from a negative to a positive value. A double rôle is attributed to the foreign atoms: they (1) provide free electrons and (2) scatter electron waves.—J. S. G. T.

**\*Vapour Pressure Curve of Thallium at Very Small Vapour Densities.** F. Müller (*Helv. Phys. Acta*, 1934, 7, 491-492; *Brit. Chem. Abs.*, 1935, [A], 438).—Cf. *Met. Abs.*, this vol., p. 560. Values between 350° and 500° C. are deduced from the absolute intensity of absorption of the 3776 Å. thallium line in the vapour.—S. G.

**\*The Transformation of  $\beta$ -Tin into the  $\alpha$ -Modification.** M. M. Chertok (*Zhurnal Tekhnicheskoy Fiziki (J. Tech. Physics)*, 1935, 5, (4), 711-717).—[In Russian.] The transformation of  $\beta$ - into  $\alpha$ -tin is influenced by temperature,

grain-size, and purity. The automatic formation of  $\alpha$ -phase nuclei occurs also at temperatures as high as  $-20^{\circ}\text{C}$ . Plastic deformation of  $\beta$ -tin at  $-20^{\circ}$  and  $-30^{\circ}\text{C}$ . considerably accelerates the formation of  $\alpha$ . In some cases very rapid formation of continuous fields of  $\alpha$ -tin is possible (spontaneous transformation).  
—N. A.

**\*The Linear Velocity of Transformation of White Tin into Grey.** A. Komar and B. Lasarew (*Physikal. Z. Sowjetunion*, 1935, 7, 468–473).—[In English.] The linear velocity of transformation of white into grey tin was investigated in thin single crystals in the range  $18^{\circ}$  to  $80^{\circ}\text{C}$ . The dependence of the transformation on supercooling was determined. Velocities about 200 times greater than any hitherto measured were found. To explain these large velocities, factors other than pressure must be taken into account.—J. S. G. T.

**\*Magnetism of Tin.** S. Ramachandra Rao (*Nature*, 1934, 134, 288).—White tin has a small paramagnetic susceptibility equal to  $0.025 \times 10^{-6}$ ; grey tin is strongly diamagnetic, its susceptibility being  $0.35 \times 10^{-6}$ . The susceptibility of colloidal white tin becomes diamagnetic as the particle size decreases, the susceptibility attaining larger values with decrease of particle size. On melting and recrystallizing, the white tin again becomes paramagnetic. The paramagnetic susceptibility of white tin is not an atomic property but depends on crystal structure.—J. S. G. T.

**\*Magneto-Caloric Effect in Superconducting Tin.** K. Mendelssohn and J. R. Moore (*Nature*, 1934, 133, 413).—The adiabatic magnetization and demagnetization of superconducting tin were examined. A cooling effect accompanied magnetization; demagnetization was accompanied by heating, and this heating was always greater than the corresponding cooling owing to the occurrence of heating due to eddy currents in both cases. The cooling effect observed at the various temperatures were as follows: at  $3.3^{\circ}\text{K}$ .,  $0.05^{\circ}$ ; at  $3.0^{\circ}\text{K}$ .,  $0.11^{\circ}$ ; at  $2.7^{\circ}\text{K}$ .,  $0.21^{\circ}$ ; at  $2.5^{\circ}\text{K}$ .,  $0.33^{\circ}$ .—J. S. G. T.

**\*Superconductivity of Films of Tin.** E. F. Burton (*Nature*, 1934, 133, 459).—Employing d.c., it is found that thin films of tin cease to show superconductivity when the films are themselves plated over with a film of a non-superconducting metal, e.g. copper or nickel. As the film of tin increases in thickness, a thickness is reached at which the superconducting property of the tin film is not lost by surface plating.—J. S. G. T.

**\*The Effect of Magnetic Fields on the Superconductivity of Thin Films of Tin.** A. D. Misener, H. Grayson Smith, and J. O. Wilhelm (*Trans. Roy. Soc. Canada*, 1935, [iii], 29, (Sect. III), 13–21).—The critical magnetic field necessary to interrupt the superconducting state of tin is found to be considerably greater for thin films than for the massive metal. Greater transverse fields are required than longitudinal fields. The transition from superconductivity to normal resistance is comparatively gradual for the films, and marked hysteresis is found. The critical magnetic field at a definite temperature is decreased by increasing the current through the film; this is apparently a true current-effect.—J. S. G. T.

**The Apparent Thermionic Constant,  $A$ , of Clean Metals [Tungsten, Tantalum, Molybdenum].** A. L. Reimann (*Nature*, 1934, 133, 833).—The apparent thermionic constant,  $A$ , of some clean metals, e.g. tungsten, tantalum, and molybdenum, is definitely less than the theoretical upper limit for this quantity  $A$ . This defect is attributed to the variation with temperature of the effectively-free electrons per unit volume of the metal. Values of the difference so calculated for these three metals are of the correct order of magnitude.—J. T.

**Refraction of Slow Electrons by Sublimed Tungsten.** W. I. Kassatotschkin (*Acta Physicochimica U.R.S.S.*, 1935, 2, 317–336).—[In German.] It is shown, *inter alia*, that the value of the internal potential of tungsten is  $10.5 \pm 2\text{ v}$ . The experimental results can be brought into agreement with those obtained by Rupp and Sproull with single crystals if it be assumed that refraction of



the electrons occurs within a layer of unoriented microcrystals coating the surface of the single crystals.—J. S. G. T.

**\*Velocity of Decomposition of Ammonia by Thoriated Tungsten.** I. Motschan, I. Perevesenseff, and S. Roginsky (*Acta Physicochimica U.R.S.S.*, 1935, 2, 203-210).—[In German.] The presence of thorium is found to be without appreciable effect on the catalytic decomposition of ammonia at a tungsten surface. The mechanism of the decomposition is discussed.—J. S. G. T.

**\*Embrittlement of Uranium by Small Amounts of Aluminium and Iron.** H. W. Highriter and W. C. Lilliendahl (*Trans. Amer. Inst. Min. Met. Eng.*, 1935, 117, 381-385; discussion, 385-386).—See *Met. Abs.*, this vol., p. 459.  
—S. G.

**\*The Preparation of Pure Finely-Powdered Vanadium.** Theodor Döring and Johannes Geiler (*Z. anorg. Chem.*, 1934, 221, 56-62).—The production of extremely pure, finely powdered vanadium by the reduction of vanadium trichloride by hydrogen at 900° C. is described. The method was originally employed by Roscoe, and yields a product exceeding in purity that obtained by reduction of the oxide by hydrogen at about 1300° C. or by carbon, aluminium, or "Mischmetall."—J. S. G. T.

**\*A Study of the Action of Acids on Zinc at Pressures of from One to Thirty Thousand Atmospheres.** Thos. C. Poulter and Glen E. Frazier (*J. Physical Chem.*, 1934, 38, 1131-1140).—The velocity of the reaction  $\text{Zn} + \text{H}_2\text{SO}_4 \rightarrow \text{ZnSO}_4 + \text{H}_2$  is found to be affected very little by pressures up to 8000 atm. Between that pressure and 30,000 atm. very little reaction occurs. An electric cell having zinc and hydrogen electrodes has its polarity reversed by a pressure sufficient to form ice VI. At a pressure of 8900 atm. at 20° C. in the presence of platinized platinum the reaction  $4\text{H}_2 + \text{H}_2\text{SO}_4 \rightarrow \text{H}_2\text{S} + \text{H}_2\text{O}$  is predominant so long as a hydrogen concentration remains.—J. S. G. T.

**\*Superconductivity and the Hall Effect [Zinc].** B. Lasarew (*Nature*, 1934, 134, 139).—Results obtained with single crystals of zinc show that zinc belongs to the group of superconductors which are superconducting in one particular crystallographic direction only, and indicate that zinc strongly supports the rule for superconductors proposed by L. (*Physikal. Z. Sowjetunion*, 1933, 4, 567). J. S. G. T.

**Remarkable Optical Properties of the Alkali Metals.** R. de L. Kronig (*Nature*, 1934, 133, 211-212).—K. advances an explanation of Wood's results relating to the reflecting powers of the alkali metals (*Met. Abs. (J. Inst. Metals)*, 1933, 53, 339) differing somewhat from that advanced by Zener (*Nature*, 1933, 132, 968).—J. S. G. T.

**Problems of Super-Rare and Dispersed Elements.** D. I. Shtsherbakov (*Redkie Metalli (Rare Metals)*, 1935, (3), 28-38).—[In Russian.] A review of the properties, occurrence, and application (actual as well as potential) in scientific and technical spheres of beryllium, rubidium, caesium, tellurium, gallium, indium, germanium, selenium, thallium, tantalum, hafnium, niobium, rhenium, and rare earth elements.—D. N. S.

**†Internal Stresses [in Metals].** Charles S. Barrett (*Metals and Alloys*, 1934, 5, 131-135, 154-159, 170-174, 196-198, 224-226).—Of the many methods proposed for determining the intensity and distribution of internal stresses in metals only Sachs' boring-out method for rods and tubes and Dawidenkow's split tongue and ring method for tubes are not dependent on unlikely assumptions; for the determination of plane stress distribution Mather's method of making strain-gauge measurements around a drilled hole gives satisfactory results. The Laue method has serious limitations since it does not give quantitative results, and even qualitative results are unreliable since it confuses elastic strains with the complex lattice movements produced by plastic flow; when the latter has been appreciable the results are entirely untrustworthy. The radial widening of lines in powder diffraction patterns is related to micro-

scopic internal stresses, but the relation between width of lines, type of deformation, and amount of deformation is still obscure. Crystal recovery sharpens lines while recrystallization and grain-growth render them "spotty." The relative intensity of diffraction in the different orders is altered by plastic deformation even with metals that do not show strain-widening of diffraction lines; this is attributed to changes in the electron distribution in the deformed crystals; the absolute intensity of diffraction is changed very little by elastic stresses in metals. The large amount of research which has been devoted to season-cracking of brass has revealed many ways of avoiding the trouble, but so far no exact relation between stress intensity or distribution and tendency to crack has been established. A bibliography of 118 references is included.

—A. R. P.

**Strength of Metal Single Crystals.** R. Roscoe (*Nature*, 1934, 133, 912).—The condition of the surface exercises a surprisingly large effect on the initial tensile strength of cadmium single crystals. When the crystals are grown in the presence of oxygen, there is a marked increase in the resistance to shear. Nitrogen, carbon dioxide, and water vapour produce no such effect, which is therefore attributed to a surface film of oxide; the effect cannot be attributed to any strength of the oxide film. It is suggested that the ideal metal lattice has very little or no strength; surface films can prevent initiation of slip.

—J. S. G. T.

**\*An Investigation of the Nature of Creep under Stresses Produced by Pure Flexure.** H. J. Tapsell and A. E. Johnson (*J. Inst. Metals*, 1935, 57, 121–137; discussion, 137–140).—Deals with the results obtained in a study of the stresses and strains arising when a material is subjected to bending moments in conditions which produce creep. For experimental reasons, it was necessary to use a material which would creep at air temperature, and for this reason lead of commercial purity was chosen. Apparatus was constructed by which a beam of lead was subjected to uniform bending moment, and measurements of the creep of the beam were recorded. The whole equipment was housed in a chamber maintained at constant temperature. Tensile creep tests on the material of the beam were also carried out at constant temperature in order to provide stress-strain data for the calculation of the stresses in the beam. The investigation led to the following conclusions: (1) in the case of a lead beam creeping under stresses produced by pure flexure, plane sections continue to remain plane; (2) the redistribution of stress arising from creep is complete within  $\frac{1}{2}$  hr. after application of a bending moment, and the stresses continue unaltered with time; (3) the behaviour of the beam under flexure may be fairly computed solely from the relations between tensile stress and rate of strain corresponding to any period of tensile creep testing on the material of the beam.—H. J. T.

**\*Practical Strength.** A. V. Stepanov (*Zhurnal Tehnicheskoy Fiziki* (*J. Tech. Physics*), 1935, 5, (2), 349–361).—[In Russian.] The strength of crystals and the factors governing rupture depend mainly on changes brought about in the crystal by plastic deformation.—N. A.

**Physical Foundations of the Mathematical Theory of the Plasticity of Metals.** N. A. Artemiev (*Zhurnal Eksperimentalnoi i Teoreticheskoi Fiziki* (*J. Exper. and Theoret. Physics*), 1935, 5, 563–584).—[In Russian.] Review and criticism.

—N. A.

**Apparent Increase of the Plasticity of Metals in Plastic Torsion with Change of Sign.** V. D. Kuznetsov (*Zhurnal Eksperimentalnoi i Teoreticheskoi Fiziki* (*J. Exper. and Theoret. Physics*), 1935, 5, 550–555).—[In Russian.] An explanation of a phenomenon previously observed by K. (*Met. Abs.*, this vol., p. 207).

—N. A.

**Crystal Plasticity.** E. Orowan (*Schweiz. Archiv angew. Wiss. Tech.*, 1935, 1, 117–126).—Cf. *Met. Abs.*, 1934, 1, 481. A description and analysis of

various aspects of the plasticity of crystals. It is stated that the physical relation between tension and deformation which, up to the present, has been implicitly understood in the usual conception of the plastic properties of crystals is non-existent. As for viscous liquids, the tension determines the rapidity of deformation. Accordingly, a great number of the results of experiments to date lose their value from the physical point of view and must be subjected to strict scrutiny. This theme is developed along purely speculative lines.—W. A. C. N.

**A Theory of the Plastic State in Metals.** J. R. Fullard (*Engineer*, 1935, 160, 138-139).—Plasticity is considered from the point of view of surface tension phenomena.—R. Gr.

**Non-Ferrous Metals in Relation to Prolonged Stress.** — (*Met. Ind.* (Lond.), 1935, 47, (10), 223-227; and (summary) *Light Metals Research*, 1935, 4, 86-88).—A review, with a bibliography, of creep tests on non-ferrous metals and alloys. The work of Andrade is specially emphasized. The majority of creep tests have been performed under constant load rather than under constant stress, and the interpretation of results obtained by different methods is considered, especially in the case of Kennedy's work on certain light alloys.

—P. M. C. R.

**The Piobert Effect in Iron and Soft Steel** Eric W. Fell (*J. Iron Steel Inst.*, 1935, 132, 75-91; discussion, 92-97).—The Piobert effect is the name given to the permanent surface distortion which accompanies the sudden yielding of a polished bar of soft steel under increasing tensile stress. A similar effect is recorded in the case of certain non-ferrous metals. The effect appears to be associated with aggregates of similar crystals; its spread is progressive, and appears at nearly constant stress. An analysis of progressive distortion reveals some analogy with the distortion of a single crystal. A. Nadai, in correspondence, refers to the possibility of producing similar effects in non-ferrous metals and in paraffin wax, and suggests that observations on loose materials (e.g. sand) throw light on the mechanism of the process.—P. M. C. R.

**The Theoretical Strength of Materials and Their Practical Weakness.** (Sir) William Bragg (*J. and Trans. Soc. Eng.*, 1935, 26, (2), 27-41).—See *Met. Abs.*, this vol., p. 142.—P. M. C. R.

**Properties of Metals at Low Temperatures.** V. A. Smirnov and A. S. Fal'kevich (*Khimstroit*, 1934, 6, 548-551).—[In Russian.] Cf. *Met. Abs.*, this vol., p. 93. The discussion is continued.—S. G.

**An Investigation of the Properties of Welded Metals at Low Temperatures.** V. A. Smirnov and A. S. Fal'kevich (*Avtogennoe Delo (Autogenous Practice)*, 1935, (4), 3-12).—[In Russian.] A review, with some results of work on the subject.—N. A.

†**Gases in Metals.** C. A. Edwards (*Trans. Amer. Inst. Min. Met. Eng.*, 1935, 117, 13-38).—Institute of Metals Division Lecture, 1935. Recent work on adsorption of gases by molten metals is reviewed and modern knowledge of the subject is summarized with especial reference to adsorption of hydrogen in pickling and electrodeposition, to absorption of oxygen by molten silver and copper and of hydrogen by copper, and to the adsorption of gases by steel.

—A. R. P.

\***Diffusion of Gases Through Metals.** C. J. Smithells and C. E. Ransley (*Nature*, 1934, 134, 814).—The rate of diffusion,  $D$ , of hydrogen through copper, nickel, iron, and molybdenum, and of nitrogen through molybdenum is found to be related to the pressure,  $P$ , by the equation  $D = K(abP\sqrt{P})/(1 + aP)$ .—J. S. G. T.

**The Interaction of Gases with Solids.** H. W. Melville (*Nature*, 1935, 136, 899-900).—Work referred to at the discussion held by the Chemical Society, on Nov. 21, 1935, on the interaction of gases with solids is briefly discussed. Roberts's work on tungsten (*Met. Abs.*, this vol., p. 560) proves that chemi-



sorption of hydrogen on tungsten proceeds with a very small energy of activation; this is in marked contrast to the considerable energy of activation observed for metallic powders. Surface migration can be studied by Bosworth's method (*Proc. Roy. Soc.*, 1935, [A], 150, 58). The mechanism of the diffusion of gases through solids and the use of deuterium for investigating the mechanism of chemical reactions are briefly referred to.—J. S. G. T.

**\*Desorption of Gases from Sooted Metallic Surfaces in a Vacuum.** H. Behne and H. Löhner (*Ann. Physik*, 1935, [v], 22, 92-96).—S. G.

**\*The Activation of Gases by Metals.** Louis Kahlenberg, Neal J. Johnson, and Alfred W. Downes (*J. Amer. Chem. Soc.*, 1934, 56, 2218-2221).—Metals exposed to air gather on their surfaces dust particles, micro-organisms, and adsorbed sulphur compounds. Consequently, when the metals are heated in hydrogen, nitrogen, helium, argon, carbon dioxide, or oxygen there results a gas containing carbon compounds and hydrogen sulphide and having a burnt nitrogenous odour. Hydrogen passed over heated metals, therefore, gives tests for hydrogen sulphide, reduces permanganate, ferric salts, and blue starch iodide paper. Hydrogen passed over pure hot silver cannot be distinguished from ordinary pure hydrogen by chemical or spectroscopic methods. Even momentary contact of the silver with the air or with a glass rod renders it impure through adsorption of sulphur compounds. A small proportion of the hydrogen released from cathodically hydrogenated palladium and nickel reduces sulphur above 65° C.—S. G.

**\*Theory of Anomalous Specific Heats.** L. Landau (*Physikal. Z. Sowjetunion*, 1935, 8, 113-118).—[In German.] Many solids are characterized by an increase of their specific heat with temperature up to a certain critical temperature, followed by a subsequent sudden decrease. A mathematical theory of this phenomenon is developed along lines based on the work of Dehlinger.—J. T.

**†Theoretically Interesting Aspects of High-Pressure Phenomena.** P. W. Bridgman (*Rev. Modern Physics*, 1935, 7, 1-94).—Theoretical aspects of high-pressure phenomena are comprehensively reviewed. The subjects discussed include: atomic changes under pressure; volume changes and the law of force; thermal expansion and entropy at infinite pressure; periodic relations; compressibility of single crystals; two-phase equilibrium; irreversible transitions; discontinuities; electrical resistance; thermal conduction; viscosity; conditions of rupture. A bibliography of 287 references is appended.—J. T.

**Fifth Report of the Committee on Atomic Weights of the International Union of Chemistry.** G. P. Baxter, O. Hönigschmid, P. Lebeau, and R. J. Meyer (*J. Amer. Chem. Soc.*, 1935, 57, 787-794).—See *Met. Abs.*, 1935, 2, 416.—L. A. O.

**The Identity of Fermi's Reactions of Element 93 with Element 91.** A. V. Grosse and M. S. Agruss (*J. Amer. Chem. Soc.*, 1935, 57, 438-439).—Chemical tests show that the elements obtained by Fermi by bombardment of uranium with neutrons are not isotopes of element 91 since they are not co-precipitated with zirconium phosphate, and they do not appear to be element 93 since they are not soluble in alkaline media. Their identity is, therefore, still in doubt.—A. R. P.

**The Chemical Properties of Elements 93 and 94.** A. V. Grosse (*J. Amer. Chem. Soc.*, 1935, 57, 440-441).—The probable properties of these elements (if they exist) are deduced from considerations based on their position in the periodic table.—A. R. P.

**\*Fluorescence of Salts Surface-Activated by Condensed Metals.** A. Terenin and F. Clement (*Acta Physicochimica U.R.S.S.*, 1935, 1, (6), 941-960).—[In English.] A bright visible fluorescence is obtained from alkali halide salts under the action of ultra-violet light when one of the metals calcium, thallium, lead, bismuth, or cadmium is condensed, *in vacuo*, upon them. No similar fluorescence is produced when sodium vapour is condensed on the alkali halides or on silver chloride, silver iodide, or cuprous chloride.—J. S. G. T.

**\*Measurement of the Frequency of Longitudinal Vibration of Non-Magnetic Rods.** T. F. Wall (*Nature*, 1934, 133, 139).—A rod of copper, brass, or Duralumin, loaded at its bottom end, is suspended within and connected in series with a solenoid through which a current flows. A search coil surrounds the central part of the solenoid and is connected with an oscillograph. The rod is set into longitudinal vibration by a tap, and variations of e.m.f. in the search coil due thereto are recorded on the oscillogram. From the period of these variations the value of Young's modulus of the rod can be deduced. That for brass is found to be  $16.3 \times 10^6$  lb./in.<sup>2</sup>; that of Duralumin is  $9.9 \times 10^6$  lb./in.<sup>2</sup>.

—J. S. G. T.

**The Metallic State.** — (*Nature*, 1935, 136, 115).—A brief report of a discussion on this subject, held at Bristol in July, 1935. J. A. Prins discussed the absorption and emission of X-rays by metals. The absorption spectrum in crystals has a fine structure depending, in its general features, only on the structure and not on the atomic constitution of the crystal. H. W. B. Skinner showed how the study of emission bands in the ultra-soft region can give information about the occupied electron states in metals. W. L. Bragg reported the formation of a superstructure in copper-gold alloys. J. D. Bernal discussed the factors determining crystal structures of alloys, pointing out that atomic radii have often a decisive influence. H. Mark reviewed recent theories of electrical conductivity; J. A. Prins reported work on amorphous antimony. A discussion on the properties of bismuth was held. It was suggested that bismuth possesses a microcrystalline superstructure of the kind postulated by Zwicky; an alternative wave-mechanical theory was suggested. Work carried out at Munich on the electrical resistance of nickel and its alloys was reported by W. Gerlach. A discussion on superconductivity was opened by J. M. Casimir. The cause of the phenomenon is still obscure. The opinion was expressed that all theories of superconductors and non-superconductors are wrong below 4° K. The possibility of utilizing nuclear spin to reach still lower temperatures was discussed by F. Simon and E. Teller.—J. S. G. T.

**Sommerfeld's Theory of Metals.**—I. K. F. Niessen (*Nederland. Tijdschr. Natuurkunde*, 1935, 2, 71–89; *C. Abs.*, 1935, 29, 7788).—A review on different phases of the newer conceptions of the conduct of electrons in metals.—S. G.

**Surface Waves in the Electron Theory of Metals.** A.-W. Maue (*Z. Physik*, 1935, 94, 717–741).—Cf. *Met. Abs.*, this vol., pp. 94, 279. Waves composed of metallic electrons can be propagated along metal surfaces. The theory of such propagation is developed, and the contribution of these waves to metallic conduction is discussed.—J. S. G. T.

**\*A Magnetic Study of the Metallic State and the Fermi-Dirac Statistics.** Simon Freed and Harry G. Thode (*Nature*, 1934, 134, 774–775).—Particulars are given of measurements of the susceptibility of sodium (metal) and of sodium in solution in liquid ammonia. The results are briefly discussed in connection with Bloch's theory (*J. Inst. Metals*, 1929, 41, 428).—J. S. G. T.

**On the Thermal Conductivity of Metals and Some Methods for Its Determination.** E. G. Shvidkovski (*Zavodskaja Laboratoria (Works' Lab.)*, 1935, 4, 1067–1078).—[In Russian.] A review.—D. N. S.

**Interpretation of the Benedicks Effect.** Lothar Nordheim (*Nature*, 1934, 133, 100–101).—An interpretation is advanced of the Benedicks effect, i.e. the existence of thermoelectric forces in a homogeneous substance in which the gradient of temperature is asymmetrically distributed, based on the assumption that the gradient is so high that considerable variation of temperature occurs in a distance which is short compared with the mean free path of the electrons. "Back diffusion" of electrons past the discontinuity is neglected. The value of the calculated e.m.f. is of the same order of magnitude as ordinary thermoelectric potentials.—J. S. G. T.

†**Thermionic Electron Emission and Adsorption.** J. A. Becker (*Rev. Modern Physics*, 1935, 7, 95-128).—Theories and experimental work relating to thermionic electron emission and adsorption are comprehensively reviewed.—J. T.

**Theory of Some Photoelectric and Photomagnetolectric Phenomena in Semi-Conductors.** J. Frenkel (*Physikal. Z. Sowjetunion*, 1935, 8, 185-203).—[In English.] A theory of the Demer effect and of the Kikoin-Noskov effect in solid semi-conductors, e.g. selenium, is developed.—J. S. G. T.

\***Changes in Resistance of Liquid Metals in a Magnetic Field.** I. Kikoin and I. Fakidov (*Zhurnal Eksperimentalnoi i Teoreticheskoi Fiziki (J. Exper. and Theoret. Physics)*, 1935, 5, 710-711).—[In Russian.] The dependence of the alteration in the electrical resistance of pure potassium at 100° C. on the intensity of the magnetic field is determined. Above a definite field tension,  $\frac{\Delta R}{R}$  varies linearly with the intensity of the magnetic field.—N. A.

\***The Change of the Resistance of Liquid Metals in a Magnetic Field.** Ibrahim Fakidov and I. Kikoin (*Physikal. Z. Sowjetunion*, 1935, 7, 507-508).—[In English.] For the liquid alloy KNa it has been shown that the relative change of its electrical resistance,  $\Delta R/R$ , in a magnetic field,  $H$ , is given by  $\Delta R/R = aH + b$ , for values of  $H$  above a critical value of 500 oerstedt. A similar law holds for molten potassium for fields above the critical value of 3600 oerstedt.—J. S. G. T.

**Energetic and Magnetic Anisotropy in Polycrystalline Ferromagnetic Plates in a Magnetic Field.** A. Drigo (*Nuovo cimento*, 1934, 11, 345-356).—A theoretical discussion.—S. G.

\***The Theory of the Dispersion of Magnetic Permeability in Ferromagnetic Bodies.** L. Landau and E. Lifshitz (*Physikal. Z. Sowjetunion*, 1935, 8, 153-169).—[In English.] The distribution of magnetic moments in a ferromagnetic crystal is investigated mathematically. Such crystals are shown to consist of elementary layers magnetized to saturation; the width of the layers is determined. In an external magnetic field the boundaries between the layers move; the velocity of movement is determined. Expressions are derived for the magnetic permeability in periodic fields, respectively parallel and perpendicular to the axis of easiest magnetization.—J. S. G. T.

**The Elementary Theory of Galvanomagnetic Phenomena in Crystals.** J. Frenkel and T. Kontorowa (*Physikal. Z. Sowjetunion*, 1935, 7, 452-463).—[In English.] Galvanomagnetic phenomena in divalent metals with cubic symmetry are discussed in terms of the action of electric and magnetic fields on the individual charges. The results are in exact agreement with those of the much more complicated theories of Blochinzew and Nordheim for the Hall effect, and the resistance change in a transverse magnetic field. An expression is derived for the change of resistance in a parallel magnetic field, and this gives a coefficient which is in accord with the quadratic law for weak and moderate field-strengths.—J. S. G. T.

†**Gyromagnetic and Electron-Inertia Effects.** S. J. Barnett (*Rev. Modern Physics*, 1935, 7, 129-166).—Theories of the gyromagnetic- and electron-inertia effects are comprehensively reviewed. The subjects discussed include: a historical and general discussion of the phenomena; the magnet as a gyrost; magnetization by rotation; rotation by magnetization; gyroscopic magnetization by rotating fields; the experiments of Nichols and of Lebedew; Tolman and Stewart's work; the experiments of Tolman, Karrer, and Guernsey, and of Tolman and Mott-Smith; Barnett's work.—J. S. G. T.

**Magnetic Properties and Nuclear Magnetic Moments.** J. Dorfman (*Physikal. Z. Sowjetunion*, 1935, 7, 126-127).—[In English.] The possibility of the determination of values of the nuclear magnetic moments of atoms from measurements of magnetic susceptibilities at liquid helium temperatures is briefly discussed.—J. S. G. T.



**Superconduction.** R. Schachenmeier. A. Papapetrou (*Z. Physik*, 1935, 94, 812–815).—Polemical, principally as to priority.—J. G. S. T.

**Production of Heat in Superconductors by Alternating Currents.** Heinz London (*Nature*, 1934, 133, 497–498).—A theory of heat production by a.c. is given which should enable one to ascertain whether the normal electrons in a superconductor change their general properties at the transition point. If normal conduction electrons exist in the superconductor, a production of heat characteristic of each superconductor is to be anticipated.—J. S. G. T.

**\*Persistent Currents in Superconductors.** K. Mendelssohn and J. D. Babbitt (*Nature*, 1934, 133, 459–460).—Experiments are described which make it appear certain that the effective magnetic permeability of substances decreases when they become superconducting, as observed by Meissner and Ochsenfeld, the permeability does not vanish entirely, or if it does vanish, it does so only in certain regions.—J. S. G. T.

**\*Magnetic Properties of Superconductors.** E. F. Burton (*Nature*, 1934, 133, 684).—Changes of magnetic flux in 5 coils, arranged in different positions with respect to a hollow tin cylinder, occurring as the cylinder passed through the transition temperature are reported. The results support, to some extent, the conclusions of Meissner and Ochsenfeld (*Met. Abs.*, 1934, 1, 289) and supplement the work of Mendelssohn and Babbitt (preceding abstract).—J. S. G. T.

**\*Superconductivity and Fermi-Dirac Statistics.** J. A. Kok (*Nature*, 1934, 134, 532–533).—The specific heat of some elements, e.g. zinc and silver, does not follow Debye's  $T^3$  law in the non-superconducting state at low temperatures. The deviations,  $\Delta c$ , are attributable to the presence of a free-electron gas obeying the Fermi-Dirac statistics, and it is now shown that they can be calculated without reference to a parabolic law of threshold values of heat content. Satisfactory agreement between experimental and calculated values of  $\Delta c$  are found, on this basis, for thallium, tin, and indium.—J. S. G. T.

**\*Experiments on Superconductors.** T. C. Keeley K. Mendelssohn, and J. R. Moore (*Nature*, 1934, 134, 773–774).—Values of the percentage of the flux of induction at the threshold temperature which remains "frozen-in" when the external magnetic field is reduced to zero were determined as follows: mercury, 0%; tin (single crystal), 6–10%; tin (polycrystalline), 8–12%; lead, 15%; lead + 1% of bismuth, 40–80%; lead + 4% of bismuth, 80–100%; lead + 10% of bismuth, 100%; tin + 28% of cadmium (annealed or unannealed), 100%; tin + 58% of bismuth, 100%. The percentage is small for pure substances. The heat of transition does not appear at a definite field strength, but over a certain range of field strengths.—J. S. G. T.

**\*The Role of Electrons in Superconduction.** J. Stark (*Physikal. Z.*, 1935, 36, 515–516).—The effects of electric and magnetic fields on electron motion in crystals are discussed. It is suggested that the transition temperature characterizing the region of superconduction is dependent on the size of the crystallites in the crystal and the orientation of the axes of electronic crystals to the lattices of the crystallites. It is suggested that the motion of electron crystals is less impeded in a stretched wire than in a wire having many bends. It follows that the transition temperature is lower in the latter than in the former. The significance of recrystallization occurring at the bends is referred to. The dependence of the specific heats and thermoelectric properties of metals in the region of superconduction on electron motion is briefly suggested.—J. S. G. T.

**\*The Effect of Size of Crystallites on the Incidence of Superconduction.** K. Steiner and P. Grassmann (*Physikal. Z.*, 1935, 36, 516–519).—Results with tin, in which the size of crystallites present could be altered in ratio up to 10:1, show that in accordance with Stark's theory (preceding abstract), with increase of crystallite size, the transition temperature indicating the incidence of superconduction is decreased.—J. S. G. T.

**\*The Effect of Bends on the Incidence of Superconduction.** W. Meissner, K. Steiner, and P. Grassmann (*Physikal. Z.*, 1935, 36, 519-520).—Experiments with tin wire, tin foil, and wires of indium and tantalum show that, in accordance with Stark's theory (preceding abstract), the presence of bends in the wire or foil cause the temperature of transition to the superconducting state to be lowered. The effect is found to be independent of current strength, and hence, of the magnetic field, in the wire or foil.—J. S. G. T.

**An Upper Limit of the Ohmic Resistance of Superconductors.** K. Steiner and P. Grassmann (*Physikal. Z.*, 1935, 36, 525-527).—It is shown that in a circuit comprising two superconductors, the superconducting current experiences no measurable resistance at the joint between the metals. It is also established that the resistance of a bent wire in the superconducting state is immeasurably small.—J. S. G. T.

**\*An Upper Limit to the Thermoelectric Power Between Superconductors.** K. Steiner and P. Grassmann (*Physikal. Z.*, 1935, 36, 527-528).—It is shown experimentally that the thermoelectric power coeff. of a couple formed of the pure metals lead and tin in the superconducting state is less than  $5 \times 10^{-14}$  v. per degree; that for the couple tin and indium is less than  $3 \times 10^{-15}$  v. per degree.—J. S. G. T.

## II.—PROPERTIES OF ALLOYS

(Continued from pp. 568-585.)

**\*The Influence of Impurities on Certain Aluminium Alloys.** I. T. Kolenov and B. F. Grashchenko (*Legkie Metalli (Light Metals)*, 1935, (4), 40-55).—[In Russian.] The authors investigated the effect of iron (up to 1.6%), copper (up to 1.5%), zinc (up to 1%), and silicon (up to 2.5%) on the properties of Duralumin (Cu 4, Mn 0.5, Mg 0.5, Si 0.08%), Lantal (Cu 4, Si 2%), Aludur (Cu 2, Mg 0.5, Si 0.5%), Silumin (Si 12%), and "Y" alloy (Cu 4, Ni 2, Mg 1.5%) quenched from 500° C. and aged at room temperature for 6 days or at 115° C. for 16 hrs. (Lantal and "Y" alloy). Iron decreases the tensile strength and elongation of all alloys except "Y" alloy, decreases the Brinell hardness of Duralumin and Aludur, increases that of Silumin and Lantal. Copper was added only to Silumin; it decreases the tensile strength and elongation but increases the Brinell hardness. Zinc has no important effect on Duralumin and Lantal, but increases the tensile strength of Aludur and Silumin and decreases that of "Y" alloy. Silicon decreases the tensile strength, elongation, and Brinell hardness of Aludur, but has no important effect on Duralumin and "Y" alloy.—D. N. S.

**\*Alloys of Magnesium. III.—Constitution of the Magnesium-Rich Alloys Containing Aluminium and Cadmium.** J. L. Haughton and R. J. M. Payne (*J. Inst. Metals*, 1935, 57, 287-296).—The addition of cadmium to magnesium-aluminium alloys depresses the liquidus slightly, 20% cadmium lowering the liquidus temperature of an 80% magnesium-20% aluminium alloy by about 50° C., but has practically no effect at the temperature of the aluminium-magnesium eutectic. It also reduces the solubility of aluminium in magnesium to a small extent. No new phases are found up to 20% of each added element, but attention is directed to an abnormal form of precipitation which was found in some of the alloys.—J. L. H.

**\*Decomposition of Solid Solutions of Copper in Aluminium as the Result of Plastic Deformation and Subsequent Annealing.** M. I. Zacharova and S. T. Konobeevskiy (*Zhurnal Tekhnicheskoy Fiziki (J. Tech. Physics)*, 1935, 5, (7), 1134-1144).—[In Russian.] The decomposition of supersaturated solid solutions of copper in aluminium has been investigated on lines similar to those employed in the case of the silicon solution (cf. *Met. Abs.*, this vol., p. 570).

—N. A.

\***Creep Characteristics of Aluminium Alloys.** R. R. Kennedy (*Proc. Amer. Soc. Test. Mat.*, 1935, 35, (II), 218-231; discussion, 232).—See *Met. Abs.*, this vol., p. 336.—S. G.

\***The Abnormal Creep During Transformation of Metals and Alloys [Iron, Steel, Duralumin].** Keiji Yamaguchi and Kôzô Nakamura (*Rikwagakû-Kenkyû-jô Ihô* (*Bull. Inst. Phys. Chem. Res. Tokyo*), 1935, 14, 76-82; *C. Abs.*, 1935, 29, 7899).—[In Japanese.] Cf. *Met. Abs.*, this vol., p. 336. The abnormal creep during the transformation of pure iron and carbon steel, and during the age-hardening of Duralumin were worked out. Marked creep is observed when even a very weak external force acts on the iron or steel at its transition point. In Duralumin the bending increases so long as the age-hardening proceeds actively, and becomes constant with the decrease of age-hardening. The creep varies with the variation of the load (the external force), and shows qualitatively the same variation even with quite a light load.—S. G.

\***The Foundry [Aluminium] Alloy AP 33.** F. O. Ribkin (*Tekhnika Vozdushnogo Flota* (*Technology of the Aerial Navy*), 1935, (3), 29-53).—[In Russian.] The preparation, casting, working, heat-treatment, physical and mechanical properties and microstructure of the alloy are described. The composition is copper 4.2-4.5, titanium 0.25-0.45%, aluminium the remainder.—N. A.

\***Investigation of the [Aluminium] Alloy DM 31.** W. O. Kroenig (*Tekhnika Vozdushnogo Flota* (*Technology of the Aerial Navy*), 1935, (4), 70-74).—[In Russian.] The alloy DM 31 is a modification of Duralumin with superior mechanical properties due to the addition of magnesium up to 1% and silicon up to 0.6%. A further addition of 1.2-1.3% manganese is excessive and reduces both the tensile strength and the elongation. The corrosion-resistance is less than that of Duralumin owing to the higher magnesium and manganese content.—N. A.

\***Transformations in Iron-Aluminium Alloys.** C. Sykes and H. Evans (*J. Iron Steel Inst.*, 1935, 131, 225-247).—See *Met. Abs.*, this vol., p. 279.—S. G.

\***Effect of Composition on Mechanical Properties and Corrosion-Resistance of Some Aluminium Alloy Die-Castings.** E. H. Dix, Jr., and J. J. Bowman (*Trans. Amer. Inst. Min. Met. Eng.*, 1935, 117, 357-368; discussion, 368-370).—See *Met. Abs.*, this vol., p. 212.—S. G.

\***Quenching Stresses and Precipitation Reaction in Aluminium-Magnesium Alloys.** R. M. Brick, Arthur Phillips, and A. J. Smith (*Trans. Amer. Inst. Min. Met. Eng.*, 1935, 117, 102-117; discussion, 117-118).—See *Met. Abs.*, this vol., p. 569.—S. G.

\***The Solid Solubility of  $MgZn_2$  in Aluminium at Different Temperatures.** P. J. Saldau and M. I. Zamotorin (*Izvestia Instituta Fiziko-Khimicheskago Analisa* (*Ann. Inst. Anal. Phys.-Chim.*), 1935, 7, 31-38; *Brit. Chem. Abs.*, 1935, [A], 576).—[In Russian.] The solid solubility of  $MgZn_2$  in aluminium increases from 1.58% at 15° C. to 3.57% at 300° C., 13.99% at 400° C., 24.70% at 460° C., and 30% at 475° C. (eutectic).—S. G.

**A New Nickel-Aluminium Alloy [Ceralumin C].** — (*Inco*, 1935, 13, (1), 10).—The properties and uses of Ceralumin C are dealt with.—R. G.

\***Investigation of the Kinetics of the Decomposition of Solid Solutions of Silicon in Aluminium.** M. I. Zacharova (*Zhurnal Tekhnicheskoy Fiziki* (*J. Tech. Phys.*), 1935, 5, (7), 1158-1168).—[In Russian.] See *Met. Abs.*, this vol., p. 570.—N. A.

\***The Mechanical Properties of Sheet Silumin and the Possibility of Its Application in the Aviation Industry.** V. O. Gagen-Torn (*Tekhnika Vozdushnogo Flota* (*Technology of the Aerial Navy*), 1935, (7), 87-95).—[In Russian.] Alloys containing silicon 1.5-13.5 and iron 0.3-1.3% were rolled at 480°-500° C. from 32 mm. to 10 mm. reannealed at 400°-420° C. and again rolled to 4 mm. The speed of hot-rolling was 0.46 m./second, of the first cold-rolling 0.33 m./second and of the last 0.22 m./second. Cold-rolling was difficult in the case of the



13-45% silicon alloy. The best mechanical properties are obtained with alloys containing 5-10% silicon; up to 1.0% iron has no effect.—N. A.

†On the Ageing of Aluminium Alloys. J. A. Kliachko (*Zhurnal Tehnicheskoy Fiziki* (*J. Tech. Physics*), 1935, 5, (7), 1123-1133).—[In Russian.] A review. —N. A.

**The Heat-Treatment of Hardenable Aluminium Casting Alloys.** E. Söhnchen (*Giesserei*, 1935, 22, 100-108; and *Metal Treatment*, 1935, 1, 70-75, 81).—Lautal,  $\gamma$ -Silumin, and "Y" alloy harden slowly on ageing the castings at 140° C., but, after annealing at 520° C. and quenching, considerable hardening occurs at 140° C., the increase in hardness being 22% for "Y" alloy, 35% for  $\gamma$ -Silumin, and 85% for Lautal. These effects are held to be responsible for the occurrence of hard spots in castings. Three-dimensional diagrams are given showing the influence of grain-size and time of annealing on the hardness obtained by ageing. Quenching of "Y" alloy from 520° C. in water at 100° C. gives a Brinell number of 110, whereas this value is only 65 after quenching in ice-cold water and then increases to 100 in 10 days at 20° C. and to 106 in 1 hr. at 150° C. After air-cooling to 16° C. the hardness increases to 105 in 1 hr. without further heating. In all the alloys the greatest hardness is obtained with a fine-grained structure. The mechanism of artificial ageing and growth is discussed; the presence of an alternating magnetic field has no effect on the hardness obtained by heat-treatment.—A. R. P.

**\*Contribution to the Study of the System Iron-Antimony.** P. Fournier (*Rev. chim. indust.*, 1935, 44, 195-199).—An investigation by magnetic, dilatometric, thermal, and micrographic methods of a series of alloys containing 0.5-70% antimony. It is found that the magnetic change point of iron persists in alloys containing up to 60-70% antimony at the same temperature as in pure iron. Particular attention was devoted to the possibility of a transformation point in the compound FeSb. It is concluded that a transformation does occur at about 620° C., but its nature is not clear, and no change in microstructure can be observed. On the basis of the results and previous works, an equilibrium diagram of the complete system is presented.—C. E. H.

**The Latest Data on Alloys of Beryllium.** D. M. Zaslavski and B. K. Dering (*Redkie Metalli* (*Rare Metals*), 1935, (5), 41-47).—[In Russian.] A review of foreign literature.—D. N. S.

**\*Cementation of Iron and Ferrous Alloys by Beryllium.—I-III.** (Laissus.) See p. 697.

**\*Free Energy and Heat of Formation of the Intermetallic Compound CdSb.** Harry Seltz and J. C. De Haven (*Trans. Amer. Inst. Min. Met. Eng.*, 1935, 117, 218-224).—See *Met. Abs.*, this vol., p. 463.—S. G.

**\*An X-Ray Study of the Diffusion of Chromium into Iron.** Laurence C. Hicks (*Trans. Amer. Inst. Min. Met. Eng.*, 1934, 113, 163-172; discussion, 172-178).—See *Met. Abs.* (*J. Inst. Metals*), 1933, 53, 696.—S. G.

**\*The Cobalt-Molybdenum System.** W. P. Sykes and Howard F. Graff (*Trans. Amer. Soc. Metals*, 1935, 23, 249-283; discussion, 283-285).—The system was studied by microscopic, X-ray, and thermal analysis methods and by measurements of electrical resistance and thermal expansion, and the constitutional diagram constructed. Cobalt dissolves about 26% molybdenum in the solid at 1360° C., the eutectic temperature. The solid solubility of molybdenum in cobalt decreases to less than 2% at 700° C. The complete eutectic occurs near 36.5% molybdenum and consists of the hexagonal cobalt-rich solid solution,  $\gamma$  and  $\epsilon$ , an intermediate phase corresponding to CoMo. This  $\epsilon$  phase is formed from the melt on cooling by a peritectic reaction at 1550° C. between the cobalt-rich liquid and a second intermetallic phase,  $\eta$ , containing about 71% molybdenum and represented by Co<sub>2</sub>Mo<sub>3</sub>. The  $\eta$ -phase forms at 1620° C. on cooling from the melt by a second peritectic reaction between the cobalt-rich liquid and the molybdenum-rich  $\delta$ -phase.  $\eta$  decomposes at 1250° C. on

cooling into  $\epsilon$  and  $\delta$ . The  $\delta$ -phase represents the molybdenum-rich solid solution dissolving about 3% cobalt at 1600° C. The face-centred cubic form of cobalt extends to a concentration of 25% molybdenum at about 1310° C.; at this temperature it is formed as the  $\beta$ -phase, on cooling the hexagonal solid solution, by the reaction  $\gamma + \epsilon \rightleftharpoons \beta$ . At 1200° C. another hexagonal phase,  $\theta$ , containing about 25% molybdenum forms on cooling by the reaction  $\beta + \epsilon \rightleftharpoons \theta$ . This phase is stable between 1200° and 1050° C. At 1050° C.  $\theta$  decomposes by a reaction which is at present somewhat obscure, but below 1000° C. the structure is represented by  $\beta$  and another phase,  $K$ , containing about 32% molybdenum. The higher transformation point in cobalt (1020° C.) appears to be varied to about 1310° C. by the addition of 25% molybdenum, while the lower point (420° C.) is depressed to about 240° C. at a molybdenum concentration of 1 to 2%. The cobalt-rich solid solution,  $\beta$ , is subject to age-hardening above 450° C. A maximum hardness of Rockwell C 65 was developed in an alloy of cobalt + 15% molybdenum by ageing at 550° C. for 100 hrs. The hardness developed by ageing in these alloys approximates that of the cobalt-tungsten alloys, but is less resistant to prolonged heating at 600°–700° C.—S. G.

**\*Transformations in Eutectoid Copper-Aluminium Alloys. I.—Intermediate States in the Hypereutectoid Alloys.** G. Kurdjumow and T. Stellezkaja (*Zhur-nal Tehnicheskoy Fiziki (J. Tech. Physics)*, 1935, 5, 395–406 (in Russian); and *Tech. Physics U.S.S.R.*, 1935, 2, 3–16 (in German)).—A full account is given of work, the results of which have already been published (see *Met. Abs.*, 1934, 1, 565).—N. A.

**Anaconda Beryllium-Copper.** American Brass Co. (*Anaconda Publ. B-21* (2nd edn.), 1934, 19 pp.; *Bull. B.N.F.M.R.A.*, 1935, (76)).—A very extensive account is given of this material. The composition is copper with 2–2.5% beryllium, 0.25–0.5% nickel, and usually less than 1% iron; nickel is present as grain refiner. Details are given of applications, fabricating procedure, heat-treatment, soldering and electric welding, physical constants and mechanical properties, wear tests, corrosion-resistance, and metallography.—S. G.

**\*Limits of the  $\alpha$ -Phase in the System Copper-Cadmium.** S. A. Pogodin, V. I. Micheeva, and G. A. Kagan (*Izvestia Instituta Fiziko-Khimicheskogo Analisa (Ann. Inst. Anal. Phys.-Chim.)*, 1935, 7, 39–47).—[In Russian.] The solid solubility of cadmium in copper is: room temperature 1.0%, 250° C., 1.2%; 400° C., 1.6%; 475° C., 2.1%; 525° C., 2.5%, and 550° C., 2.8%. The limits of the  $\alpha$ -phase were determined.—S. G.

**\*The Inter-Relation of Age-Hardening and Creep Performance. I.—The Age-Hardening of Nickel-Silicon-Copper Alloys.** C. H. M. Jenkins and E. H. Bucknall. With an Appendix on The Relationship of Time, Temperature, and Concentration as Factors in Age-Hardening. E. H. Bucknall and C. H. M. Jenkins (*J. Inst. Metals*, 1935, 57, 141–171; discussion, 171–191).—A study of the age-hardening of nickel-silicon-copper alloys containing 3 and 5% nickel + silicon in the atomic ratio 2 Ni : 1 Si, was carried out as a preliminary to the study of the inter-relation of the age-hardening of this material and its creep performance, and has provided sufficient information to serve as a basis for the creep test programme and to assist in the interpretation of the creep results. The alloy containing 3% nickel + silicon when quenched from 900° C. undergoes age-hardening at 300°–750° C. The maximum hardness is attained progressively more rapidly the higher the ageing temperature, being reached, for example, in more than 64 days at 400° C. and in less than 1 minute at 700° C. In general, a linear relationship appears to apply between the logarithm of the time and the reciprocal of the absolute temperature of attainment of maximum hardness. The maximum hardness when attained is greater the lower the ageing temperature, and its attainment is generally followed by softening. Microscopical and chemical evidence of the progress of ageing was obtained,

but X-ray study was not of great assistance in this instance. In the Appendix consideration is given to points relating to the age-hardening of nickel-silicon-copper alloys and their comparison with information in the literature relating to other age-hardenable alloys. Particular attention is directed to the importance of the relationship between temperature and time of attainment of maximum hardness, which is shown to be of general application. A similar relationship applies to the attainment of maximum resistivity during ageing. These relationships are regarded as confirming the commonly accepted theory of age-hardening. A bibliography of 38 references is appended.—C. H. M. J.

**\*Physical and Casting Properties of the Nickel Silvers [Liquidus Points of Copper-Nickel-Zinc-Tin and Copper-Nickel-Zinc-Lead Alloys].** T. E. Kihlgren, N. B. Pilling, and E. M. Wise (*Trans. Amer. Inst. Min. Met. Eng.*, 1935, 117, 279-309; discussion, 309-312).—See *Met. Abs.*, this vol., p. 151.—S. G.

**\*X-Ray Study of [Phase Boundaries of] Copper-Silver Alloys.** E. A. Owen and Joseph Rogers (*J. Inst. Metals*, 1935, 57, 257-266).—The phase boundaries in the thermal diagram of copper-silver alloys were determined by the X-ray method. A general survey showed that the phase fields were the same as those in the generally accepted diagram of the system. More detailed investigation with the precision X-ray camera yielded accurate values of the solubilities of copper and silver in each other. These values are compared with the more recently determined values, with which they are found to be in fair agreement. The solubilities of copper in silver and of silver in copper at 778° C. were found, respectively, to be 8.5 and 8.4%. These solubilities decrease to 1.8 and 1.4% at 500° C., and to 0.2 and 0.1% at 200° C. The extrapolated experimental curves indicate that the one metal is almost insoluble in the other at room temperature.—AUTHORS.

**\*X-Ray Investigation of [the Phase Boundaries of] Certain Copper-Tin Alloys.** E. A. Owen and John Iball (*J. Inst. Metals*, 1935, 57, 267-284; discussion, 284-286).—The  $\alpha$ -phase boundary of the copper-tin alloys was determined by X-ray analysis between 750° and 300° C. Its position between 750° and 500° C. is moved in the direction of slightly higher tin content, but between 500° and 300° C. in the direction of lower tin content than that of the boundary as previously determined. The maximum solubility of tin in copper occurs at about 520° C., the temperature corresponding to the ( $\beta$ ) to ( $\alpha + \delta$ ) transformation. The parameter of the  $\delta$ -phase is found to lie between 17.917 and 17.924 A. at 480° C., but the measurements are not considered sufficiently extensive to decide whether there exists a definite region of solubility for this phase. The  $\eta$ -phase is a solid solution the range of which does not exceed 1.5% copper by weight at 380° C. The atomic volume of the copper-saturated  $\eta$ -phase at this temperature is found to be 14.124 A.<sup>3</sup> and that of the tin-saturated phase 14.177 A.<sup>3</sup>. The results so far obtained suggest that a transformation of ( $\delta$ ) into ( $\alpha + \eta$ ) occurs at a temperature slightly higher than 300° C., and that the copper-saturated boundary of the  $\eta$ -phase is not exactly vertical between 380° and 300° C.—AUTHORS.

**\*The Properties of Some Special Bronzes.** D. Hanson and M. A. Wheeler (*J. Inst. Metals*, 1935, 57, 93-108; discussion, 108).—Additions of aluminium, manganese, aluminium plus manganese, iron, and silicon were made to copper-tin bronzes. (1) *Aluminium*.—Within the range of compositions investigated, alloys consisting of one solid solution work readily, hot or cold. Alloys possessing a duplex structure can be worked with much greater difficulty, and are specially difficult in hot-working. The range of compositions in which easy working properties can be obtained can be extended by annealing duplex alloys to give a homogeneous structure. Annealed alloys possess very good ductility; the maximum tensile strength attained in annealed alloys was 30 tons/in.<sup>2</sup> in an alloy containing 4% aluminium and 5% tin. Alloys containing 2% or more aluminium are fairly resistant to oxidation at high temperatures,



particularly if the cast surface is not damaged. Polished alloys have a pleasing appearance, and are fairly resistant to tarnishing in the air. The scale formed when the alloys are heated is very difficult to remove, either mechanically or by pickling processes. (2) *Manganese*.—Manganese has a relatively small influence on the working properties of a 5% tin-bronze. As much as 6% manganese must be added before an appreciable embrittling effect is apparent. Alloys within the range of composition investigated can be worked hot or cold. Manganese increases the softening temperature of the tin-bronzes. (3) *Aluminium and Manganese*.—Copper-tin bronzes containing aluminium and manganese, within the range investigated, are difficult to cold-work, without annealing, if the aluminium content exceeds about 0.25%. With up to about 3% aluminium they may be cold-worked if they are previously rendered homogeneous in structure by annealing. Aluminium increases the tensile strength of manganese-tin bronzes, without appreciably reducing the ductility. (4) *Iron*.—Iron, in the form of American washed iron, alloys readily with copper, and 4% of iron can be incorporated without difficulty. No trouble was experienced in obtaining good castings. Iron-tin-copper alloys containing 5% tin and up to 4% iron can be rolled, and the ductility decreases only slightly even when 3 or 4% of iron is present. Iron up to 1.5% has little effect on the tensile properties of a 5% tin-bronze, but 2% or more of iron increases the tensile strength at the expense of the ductility. The iron is distributed uniformly throughout the solid alloy in the form of small particles, the structures being very similar to those of iron-copper alloys containing no tin. 4% iron greatly refines the cast structure of a 5% tin-bronze. (5) *Silicon*.—Silicon has a marked effect on the cold-working properties of a 5% tin-bronze. An alloy containing 3% silicon can be cold-worked only with great difficulty in the "as cast" condition; after annealing at 800° C. for 4 hrs. the cold-working properties are slightly increased. The addition of 4% of silicon to a 5% tin-bronze renders the material unworkable both hot and cold. The addition of silicon greatly increases the strength of a tin-bronze.—D. H.

\***Some Tests on Tin-Bronzes at Elevated Temperatures.** J. W. Bolton (*Proc. Amer. Soc. Test. Mat.*, 1935, 35, (II), 204-212; discussion, 213-217; and (slightly condensed) *Met. Ind. (Lond.)*, 1935, 47, 63-65).—See *Met. Abs.*, this vol., p. 339.—S. G.

\***Observations on the Porosity and Segregation of Two Bronze Ingots.** N. P. Allen and S. M. Puddephat (*J. Inst. Metals*, 1935, 57, 79-86; discussion, 86-92).—The distribution of porosity and the variation in copper content in two 10% tin-bronze ingots were found to be influenced principally by the flow of heat during solidification. There was a close connection between the porosity and segregation of the ingots.—N. P. A.

\***Equilibrium Relations in the Copper Corner of the Ternary System Copper-Tin-Beryllium.** Elbert S. Rowland and Clair Upthegrove (*Trans. Amer. Inst. Min. Met. Eng.*, 1935, 117, 190-215; discussion, 215-217).—See *Met. Abs.*, this vol., p. 150.—S. G.

**Lead in Gun-Metal Melts.** B. P. Selivanov and A. I. Shultin (*Sobshenia Vsesoyuznogo Instituta Metallurg. (Communic. Pan-Union Inst. Metals)*, 1931, (3/4), 79-80; *Brit. Chem. Abs.*, 1933, [B], 66).—[In Russian.] The structural distribution of lead affects the mechanical properties. More than 8-9% lead should be avoided. Treatment at 600°-700° C. for 4-6 hrs. is recommended.—S. G.

\***The Transformation of  $\beta$ -Brass and Related Phenomena.** Hellmuth v. Steinwehr (*Forschungen u. Fortschritte*, 1934, 10, 407-408).—Literature relating to the nature of the transformation occurring in  $\beta$ -brass is briefly reviewed. v. S. has determined the value of the heat-tone characterizing the transformation in  $\beta$ -brass (50-54% copper), and the value found is 3.0 k.cal./grm. developed between 475° and 430° C. Values of thermoelectric power, thermal

expansion, and change of electrical resistance with temperature were likewise determined. The results are independent of retardation effects. The general behaviour of the alloy resembles that found for iron, cobalt, and nickel in the neighbourhood of their respective Curie points.—J. S. G. T.

**\*The Influence of Manganese on the Mechanical Properties of ( $\alpha + \beta$ )-Brass (Muntz Metal).** V. O. Gagen-Torn (*Metallurg (Metallurgist)*, 1935, (1), 74-81). —[In Russian.] Tests on brasses containing 56, 58, and 61% copper and 0.17, 0.23, 1.79, and 4.27% manganese showed that manganese increases the tensile strength and hardness of all specimens, decreases the elongation of specimens containing 61% copper, increases the elongation of specimens containing 56%, and has no effect on the elongation of those containing 58% copper.—N. A.

**Tungum Alloy.** —(*Engineering*, 1935, 140, 9).—Outlines the properties and applications of Tungum (copper, 81-84; aluminium, 0.75-1.20; nickel, 0.85-1.40; silicon, 0.80-1.30%; zinc the remainder).—R. Gr.

**Nickel-Brass.** —(*Nickel-Handbuch*, 1935, 22 pp.).—Part of the ternary nickel-copper-zinc diagram is reproduced to illustrate the composition and structure of the nickel-brasses. The effect of small additions of other metals is noted. The electrical, mechanical, and other properties, and resistance to corrosion and to high temperatures of these alloys are discussed, and their manufacture and subsequent treatment and finishing are dealt with. The applications of the nickel-brasses are described.—P. M. C. R.

**A Research into the Properties of Copper-Zinc-Silicon Alloy Wire of Fine Gauge.** H. H. Parrett (*Wire Industry*, 1935, 2, 271-273, 275).—Alloys of copper with zinc 15 and silicon 2-3% can be drawn into wire as readily as 93 : 7 phosphor-bronze, since the silicon-rich constituent which is precipitated in the matrix of  $\alpha$ -solid solution breaks up and disperses in a similar way to the tin-rich constituent of the bronze. In the hard-drawn state the strength and ductility are the same as those of the bronze, but in the annealed state the strength is much higher, being about 35 tons/in.<sup>2</sup>, and the elongation is about 40%. The resistance to corrosion is equal to or better than that of phosphor-bronze.—A. R. P.

**\*Thermal and Electrical Conductivities of Copper Alloys.** Cyril Stanley Smith and Earl W. Palmer (*Trans. Amer. Inst. Min. Met. Eng.*, 1935, 117, 225-245).—See *Met. Abs.*, this vol., p. 571.—S. G.

**\*Hardness Study of Transformations in Gold-Copper Alloys.** H. H. Asher (*J. Dental Research*, 1934, 14, 349-358; *Brit. Chem. Abs.*, 1935, [A], 693).—Cf. *Met. Abs.*, 1934, 1, 293. The system copper-gold is an unbroken series of solid solutions with 1 major and 2 minor lattice changes, which are unaffected by heat-treatment.—S. G.

**\*Some Physical and Metallurgical Properties of Lead-Calcium Alloys for Storage Cell Grids and Plates.** Earle E. Schumacher and G. S. Phipps (*Trans. Electrochem. Soc.*, 1935, 68, 309-316; discussion, 316-319; and *Bell Telephone System Tech. Publ., Metallurgy, Monograph B-884*, 1935, 8 pp.).—See *Met. Abs.*, this vol., p. 507.—S. G.

**A New Bearing Metal—a Lead-Base Alloy.** C. H. Hack (*Metal Progress*, 1935, 27, (5), 61-62, 72).—Recently developed bearing metals for heavy loads at comparatively high temperatures include the lead-bronzes, a cadmium alloy containing 1.25-1.5% nickel, and two lead-base alloys, Bahnmittel (lead about 98, sodium and calcium each 0.5%, small amounts of lithium and aluminium) and Satco. The latter contains about 97.5% lead, 1% tin, and small additions of calcium and other metals. A table shows its tensile and compressive strengths, hardness, and elongation at temperatures from 26° to 200° C., and the results of service tests are quoted.—P. M. C. R.

**\*Magnetic Properties and Critical Currents of Superconducting Alloys [PbTi<sub>2</sub>].** G. N. Rjabinin and L. W. Schubnikow (*Physikal. Z. Sowjetunion*, 1935, 7, 122-125).—[In English.] Cf. *Met. Abs.*, this vol., p. 422. The superconducting

characteristics of the lead-thallium alloy of composition PbTl, and of an alloy containing lead 65 and bismuth 35% are investigated. The former becomes superconducting at 3.75° K. The behaviour of the alloys in magnetic fields is discussed.—J. S. G. T.

**\*The Solid Solubility of Aluminium in Magnesium as a Function of Temperature.** P. J. Saldau and M. I. Zamotorin (*Izvestia Instituta Fiziko-Khimicheskogo Analisa* (Ann. Inst. Anal. Phys.-Chim.), 1935, 7, 21–30; *Brit. Chem. Abs.*, 1935, [A], 576).—[In Russian.] The solid solubility of aluminium in magnesium was found to be 20°–300° C., 6.08; 400° C., 10.9; 436° C., 12.6% (eutectic).—S. G.

**\*Kinetics of the Decomposition of a Solid Solution of Aluminium in Magnesium.** M. I. Zacharova and W. K. Tschikin (*Zhurnal Tekhnicheskoy Fiziki* (J. Tech. Physics), 1935, 5, (6), 1076–1081).—[In Russian.] See *Met. Abs.*, this vol., p. 568.—N. A.

**\*Solid Solubility of Copper in Magnesium.** N. I. Stepanov and I. I. Kornilov (*Izvestia Instituta Fiziko-Khimicheskogo Analisa* (Ann. Inst. Anal. Phys.-Chim.), 1935, 7, 89–98).—[In Russian.] Conductivity, temperature coeff. of conductivity, and hardness data indicate that the solubility of copper in magnesium increases from 0.2% at 300° C. to 0.3% at 400° C. and to 0.55% at 480° C.—S. G.

**\*Is an Intermetallic Homogeneous Phase Formed in the Magnesium-Manganese System?** E. F. Bachmetew and J. M. Golovchinev (*Acta Physico-chimica U.R.S.S.*, 1935, 2, 571–574).—[In German.] See *Met. Abs.*, this vol., p. 577.—J. S. G. T.

**\*Some Factors Affecting the Setting of a Dental Amalgam.—I–IV.** Marie L. V. Gayler (*Brit. Dental J.*, 1933, 54, 269–288; 1934, 56, 605–623; 1935, 58, 145–160).—(I.—) Preliminary tests on a standard commercial dental amalgam indicated that the most important factors affecting the changes during setting are the pressure exerted on mixing the alloy and mercury in the mortar, the time of mixing and kneading, and the packing pressure; times of standing between the various operations and squeezing out the mercury after kneading have little effect. A contraction of less than 4 microns in the standard cylindrical test-piece is obtained with an alloy: mercury ratio of 1:1.75, mixing for 1½ minutes, kneading for 2 minutes, and packing at 255–382 kg./cm.<sup>2</sup>. A 6-day test period is the maximum permissible. (II.—) The results obtained in (I) are applied to the filling of test “teeth” of steel or porcelain composition; under these conditions an initial contraction is obtained which is objectionable. This effect is eliminated by mixing the alloy and mercury in a rubber thumb-stall between the fingers, since this operation does not crush the alloy particles and the reaction proceeds more slowly. (III.—) The suitability of various silver alloys for dental amalgams was tested under a standard set of conditions; the results indicate that the tin content is extremely critical and should be between the limits of 25 and 27% to keep the expansion of the amalgams below 4 microns. Additions of small amounts of copper and zinc effect no appreciable improvement in the amalgam. (IV.—) After filling teeth with an amalgam of mercury with the 73–75% silver–27–25% tin alloy and hardening the amalgam contains 13–16% tin and 40–47% mercury, the amount of mercury mixed with the alloy for packing into the tooth having no effect on the composition of the final amalgam. The amount of tin removed by the excess mercury when pressing the amalgam into the cavity is less than 2% of the original weight of tin in the alloy unless this exceeds 27%.—A. R. P.

**\*The Preparation and Properties of Amalgams of Silver, Tin, and Zinc.** Kazimierz Duczko (*Przemysl Chem.*, 1935, 19, 10–13; *C. Abs.*, 1936, 30, 66).—*Cf. Met. Abs.*, this vol., p. 341. The two amalgams with highest silver content were prepared by mixing mercury with electrolytic silver. All the others were prepared by the electrolytic method—depositing each metal from its anode



through a solution of its salt and to the mercury anode. Single potentials were measured against a hydrogen electrode. After preparation the amalgams

Metal in Amalgam, %.	Brinell Hardness.	Density.	Resistivity, Ohm. cm. 36°. $\times 10^{-4}$ .	$E_a^{18^\circ}$ .	$E_a^{23^\circ}$ .
Ag, 47.02	103.00	13.09	0.042	0.4381	0.8290
Ag, 32.67	112.00	14.25	0.045	0.3493	0.8396
Ag, 32.52	18.50	12.34	0.187	0.7085	0.8336
Ag, 27.47	20.00	13.26	0.093	0.6512	0.8410
Ag, 21.25	8.7	13.40	0.103	0.6374	0.8357
Sn, 79.69	8.00	7.95	0.088	0.2350	0.2119
Sn, 79.43	7.40	8.04	0.081	0.2325	0.2119
Sn, 72.09	6.42	8.36	0.076	0.2290	0.2119
Zn, 42.55	15.20	10.54	0.069	0.7538	0.7355
Zn, 32.23	13.40	11.34	0.128	0.7696	0.7295
Zn, 31.65	13.30	11.49	0.119	0.7519	0.7332

were pressed under a pressure of 2500 kg. Amalgams of silver and tin form chemical compounds, while those of zinc form only an ordinary mixture. This is in agreement with results of Preston and of Stenbeck.—S. G.

**\*A Study of the Molybdenum-Carbon System.** W. P. Sykes, Kent R. Van Horn, and C. M. Tucker (*Trans. Amer. Inst. Min. Met. Eng.*, 1935, 117, 173-186; discussion, 186-189).—See *Met. Abs.*, this vol., p. 579.—S. G.

**\*Aluminium-Copper-Nickel Alloys of High Tensile Strength Subject to Heat-Treatment.** W. A. Mudge and Paul D. Merica (*Trans. Amer. Inst. Min. Met. Eng.*, 1935, 117, 265-276; discussion, 276-278).—See *Met. Abs.*, this vol., p. 341.—S. G.

**Electrical Resistance Alloys: Why Nickel-Chromium so Successfully Serves as Heating Element Material.** Fred P. Peters (*Trans. Electrochem. Soc.*, 1935, 68, 29-40; discussion, 40-42).—See *Met. Abs.*, this vol., p. 509.—S. G.

**Magnetic Materials. A Survey in Relation to Structure.** W. C. Ellis and Earle E. Schumacher (*Metals and Alloys*, 1934, 5, (12), 269-276; 1935, 6, (1), 26-28; and *Bell System Tech. J.*, 1935, 14, (1), 8-43).—S. G.

**\*Investigation of Variations of the Coefficients of Elasticity of the Ni-Fe Alloys Due to Magnetization.** Kiyosi Nakamura (*Z. Physik*, 1935, 94, 707-716).—The effect of magnetization on the value of Young's modulus,  $E$ , of nickel-iron alloys has been determined by a method employing the magnetostriction effect. Any effect, whether an increase or decrease in the value of the modulus, is small when the percentage of nickel present is less than 30%. Values of  $\Delta E/E$  are much smaller for the alloys than for pure nickel; the maximum value is reached in the case of alloys containing 50% nickel ( $\Delta E/E$  (max.) = 0.059) and the value thereafter is less but increases again for alloys in the range 70-90% nickel. The results agree with those anticipated from the theory of Kersten and Becker.—J. S. G. T.

**Electrical Properties of [Nickel-Iron] Wires of High [Magnetic] Permeability.** E. P. Harrison, G. L. Turney, and H. Rowe (*Nature*, 1935, 135, 961).—A pronounced "skin-effect" is exhibited by nickel-iron wires of the Mumetal group, at frequencies as low as 50 periods per second. The application to the wire of a small external axial magnetic field of the order of that of the earth causes a very large change in the wire's impedance. Changes in resistance of wires of the alloy with the magnitude of the a.c., magnetic field, and reactance are briefly referred to.—J. S. G. T.

**\*The Kinetics and Mechanism of Allotropic Transformation in the System Palladium-Copper.** Ludwig Graf (*Physikal. Z.*, 1935, 36, 489-498).—The kinetics and mechanism of allotropic modification in the palladium-copper

system of alloys containing 40–50% (atomic) of palladium are investigated by X-ray analysis and by microscopic examination of single crystals of the alloys. The transformation comprises two phases whereby the  $\beta$ -single crystal is changed into a multi-crystalline structure with a certain superstructure. This transformation superstructure is examined in detail, and the following geometrical relations between the  $\beta$ - and  $\alpha$ -phases are established:  $[311]_{\alpha}$  is parallel to  $[100]_{\beta}$ , and  $[001]_{\alpha}$  is parallel to  $(113)_{\beta}$ . It is concluded that transformation of the  $\beta$ -crystals proceeds from quite definite planes, viz. those most energetically labile, while the  $\alpha$  crystals are built up in oriented relationship to the  $\beta$  crystal from the atoms released in the transformation.—J. S. G. T.

**\*The Alloys of Palladium with Manganese.** A. T. Grigoriev (*Izvestia Instituta Fiziko-Khimicheskago Analisa* (*Ann. Inst. Anal. Phys.-Chim.*), 1935, 7, 75–87; *Brit. Chem. Abs.*, 1935, [A], 576).—[In Russian.] Palladium-manganese alloys consist of a series of solid solutions, from which PdMn separates on cooling below 1150° C. The transition points observed at 730°–797° C. and 1040°–1089° C. are ascribed to conversion of  $\beta$ - into  $\alpha$ - and of  $\gamma$ - into  $\beta$ -manganese, respectively.—S. G.

**\*Equilibrium Diagram of the Alloys of Silver with Aluminium Containing 0 to 10 Per Cent. by Weight of Aluminium.** N. W. Ageew and D. N. Shoyket (*Izvestia Instituta Fiziko-Khimicheskago Analisa* (*Ann. Inst. Anal. Phys.-Chim.*), 1935, 7, 59–73; *Brit. Chem. Abs.*, 1935, [A], 576).—[In Russian.] The limits and structure of the  $\alpha$ - and  $\gamma$ -phases are derived from microscopic, X-ray, and hardness data. The  $\beta'$ -phase decomposes at 400° C. to yield a mixture of  $\alpha$ - and  $\gamma$ -phases.—S. G.

**\*Study of a Silver-Base Dental Alloy.** Senji Hatada (*Rikwagaku-Kenkyū-jo Iho* (*Bull. Inst. Phys. Chem. Res. Tokyo*), 1935, 14, 885–890).—[In Japanese.] H. examined chemically and clinically dental alloys that are marketed as substitutes for gold, platinum, and their alloys, and found that these commercial alloys were unsatisfactory for various reasons from the point of view of the dentist. For dental purposes silver has good properties except for the surface blackening on exposure for long periods in various media. With the object of overcoming this defect, many binary silver alloys were prepared and they were examined chemically and clinically. The alloy containing silver 70 and palladium 30% has excellent mechanical properties as a dental alloy and withstands surface blackening in saliva.—S. G.

**\*The Determination of Certain Phase Boundaries in the Silver-Zinc Thermal Diagram by X-Ray Analysis.** E. A. Owen and I. G. Edmunds (*J. Inst. Metals*, 1935, 57, 297–306).—The phase boundaries in the region extending from the  $\gamma$ - to the  $\epsilon$ -phase of the silver-zinc thermal diagram, were determined by X-ray analysis. The crystal parameters are accurate in general to 1 part in 5000; in some of the determinations the accuracy is much higher than this. The results confirm the existence of the phase fields contained in the generally accepted diagram of the system, but they indicate that the positions of the boundaries need readjustment. The  $(\gamma) - (\gamma + \delta)$  boundary requires adjustment in the direction of lower silver content, by about 0.5% silver by weight at the lower temperatures, and by a progressively greater amount in the opposite direction as the temperature is increased. The  $(\gamma + \delta) - (\delta)$  boundary needs to be displaced towards the silver end of the diagram through about 4% in composition, thus reducing the width of the  $(\gamma + \delta)$  region to about half its former value. The  $(\delta) - (\delta + \epsilon)$  and  $(\delta) - (\delta + \eta)$  boundaries are more nearly parallel to the temperature axis than those shown in the thermal diagram published in the International Critical Tables. At the higher temperatures the  $(\delta) - (\delta + \epsilon)$  boundary moves towards the silver end through about 4% in composition. The  $(\delta + \epsilon) - (\epsilon)$  boundary is parallel to that in the accepted diagram, but needs an adjustment of about 1% towards the silver end of the diagram.—AUTHORS.

**\*Tantalum Carbide in Hard Alloys.** L. P. Molkov and A. V. Chochlova (*Redkie Metalli (Rare Metals)*, 1935, (1), 24-30).—[In Russian.] Tantalum carbide can be obtained by sintering tantalum powder (100 mesh) and carbon black in a carbon cartridge in hydrogen at 1600° C., for 2½ hrs., by heating tantalum sheet and carbon black at 1800° C. for 3 hrs., or preferably by heating a mixture of tantalum pentoxide and carbon black in hydrogen at 1600° C. TaC has a yellow or yellowish-grey colour and crystallizes in the cubic system,  $a = 4.42$  Å. Microscopic examination of alloys with nickel and cobalt prepared by sintering the constituents in hydrogen at 1550°-1600° C. in a Tamman furnace showed that the solubility of TaC in cobalt is 6% and the eutectic point is 35% TaC, 1445° C. The solubility of TaC in nickel is 20%. Specimens of TaC alloys with nickel and cobalt, and with molybdenum and iron (37:63) obtained by sintering or hot-pressing, had a microcrystalline fracture and a Rockwell hardness of 87-91. The TaC used contained more than the theoretical amount of carbon (6.3%); if the carbon content was less than 6.3%, the alloys had a coarse grain structure and a Rockwell hardness of 83-87. The best alloys were obtained by the hot-pressing method. A sintered alloy containing 90% TaC (7.35% carbon) and 10% nickel, with a Rockwell hardness of 90, was tested for cutting steel of 213 Brinell hardness with 3 mm. depth of cut. At a speed of 100 m./minute making a 1.5 mm. wide shaving, the tool lasted for 55 minutes, at 120 m./minute for 25 minutes, and at 150 m./minute for 18 minutes.—D. N. S.

**\*On Laboratory Methods of Preparing Infusible Substances and Examination of Their Radiations.** L. I. Kramp and M. A. Urie (Zavodskaja Laboratoria (*Works' Lab.*), 1935, 4, 1090-1092).—[In Russian.] Pressed tantalum carbide rods sintered in a high-frequency furnace at 3000° C. *in vacuo*, or at 3300° C. in an atmosphere of nitrogen or argon (temperature measurements by the disappearing filament pyrometer), gave a radiation coeff. at 1852° C. of 0.55 at  $\lambda_e = 0.655 \mu$ ; and at 2172° C. of 9.55 at  $\lambda_e = 0.654 \mu$ .—D. N. S.

**\*Carbides of High-Melting Point Metals.** G. A. Meerson (*Redkie Metalli (Rare Metals)*, 1935, (4), 6-20).—[In Russian.] Gives a detailed review of the literature on the properties of titanium, zirconium, hafnium, thorium, vanadium, niobium, tantalum, molybdenum, and tungsten carbides, and a review of the work carried out under M.'s guidance on the conditions for obtaining titanium carbide and on its properties.—D. N. S.

**The Iron-Tantalum Diagram.** — (*Metallurgist (Suppt. to Engineer)*, 1936, 11, 85-86).—A summary of a paper by W. Jellinghaus, *Z. anorg. Chem.*, 1935, 223, 362; see *Met. Abs.*, this vol., p. 464.—R. G.

**\*Physico-Chemical Investigation of the  $\gamma$ -Phase in the Alloys of Thallium with Bismuth.** N. S. Kurnakow, V. A. Ageeva, and N. W. Ageev (*Izvestia Instituta Fiziko-Khimicheskago Analisa (Ann. Inst. Anal. Phys.-Chim.)*, 1935, 7, 49-58; *Brit. Chem. Abs.*, 1935, [A], 576).—[In Russian.] The  $\gamma$ -phase contains 55-65 atomic-% bismuth, and is not a definite compound. Its space lattice corresponds with that of bismuth. The  $\gamma$ -phase exhibits superconductivity at 6.4° C.—S. G.

**\*Physico-Chemical Investigation of [Ternary] Alloys of Thallium with Bismuth and Lead.** N. S. Kurnakow and V. A. Ageeva (*Izvestia Instituta Fiziko-Khimicheskago Analisa (Ann. Inst. Anal. Phys.-Chim.)*, 1935, 7, 99-121; *Brit. Chem. Abs.*, 1935, [A], 576).—[In Russian.] Cf. preceding abstract. Thermal conductivity and microscopic data suggest the presence of the  $\gamma$ -phase in the ternary alloy in the form of a solid solution containing up to 20 atomic-% lead.—S. G.

**\*Physico-Chemical Investigation of the [Ternary] Alloys of Thallium with Bismuth and Cadmium.** N. S. Kurnakow and V. A. Ageeva (*Izvestia Instituta Fiziko-Khimicheskago Analisa (Ann. Inst. Anal. Phys.-Chim.)*, 1935, 7, 123-133; *Brit. Chem. Abs.*, 1935, [A], 576).—[In Russian.] Cf. preceding abstracts.



The presence of the  $\gamma$ -phase is established (as above) in the ternary alloy; cadmium is insoluble in the  $\gamma$ -phase.—S. G.

\***The Penetration of Molten White Metals into Stressed Steels.** W. E. Goodrich (*J. Iron Steel Inst.*, 1935, 132, 43–64; discussion, 65–66).—See *Met. Abs.*, this vol., p. 510.—S. G.

\***Impact Abrasion Hardness of Moulded Boron Carbide and of Some Cemented Tungsten and Tantalum Carbides.** Lowell H. Milligan and Raymond R. Ridgway (*Trans. Electrochem. Soc.*, 1935, 68, 131–136; discussion, 136–137).—See *Met. Abs.*, this vol., p. 510.—S. G.

\***Electron Emission of [Tungsten Molybdenum and] Tungsten-Molybdenum Alloys.** H. Freitag and F. Krüger (*Ann. Physik*, 1935, [v], 21, 697–742).—S. G.

\***Phase Changes During Ageing of Zinc Alloy Die-Castings. I.—Eutectoidal Decomposition of Beta Aluminium-Zinc Phase and Its Relation to Dimensional Changes in Die-Castings.** M. L. Fuller and R. L. Wilcox (*Trans. Amer. Inst. Min. Met. Eng.*, 1935, 117, 338–354; discussion, 354–356).—See *Met. Abs.*, this vol., p. 13.—S. G.

**Properties of Zinc-Base Alloy Die-Castings.** — (*Apex Smelting Co. Metalgrams*, Nos. 1–7, 28 pp.; *Bull. B.N.F.M.R.A.*, 1936, (85)).—These “Metalgrams” are a series of charts issued by this American company. Nos. 1–4 deal with the properties of zinc-base die-cast alloy No. 2 (zinc plus aluminium 4.1, copper 2.7, magnesium 0.03%) after exposure to water vapour at 95° C., including tensile properties, dimensional changes and impact strengths of specimens produced over a range of die temperatures and pressures. No. 5 summarizes the contents of Nos. 1–4. Nos. 6 and 7 deal similarly with alloy No. 3 (zinc plus aluminium 4.1, magnesium 0.04%).—S. G.

**Non-Metallic Inclusions in Ferro-Alloys.** B. Matuschka (*J. Iron Steel Inst.*, 1935, 131, 213–220; discussion, 221–224).—See *Met. Abs.*, this vol., p. 282.—S. G.

**Hardening of Solid Solutions (Age-Hardening).** Gunnar Hägg (*Jernkontorets Ann.*, 1935, 119, 295–300).—Reply to Benedicks (see *Met. Abs.*, this vol., p. 583).—S. G.

†**Internal Stresses [in Metals].** (Charles S. Barrett.) See p. 663.

**Selectivity of the External Photoelectric Effect of Alloys.** F. Hlučka (*Z. Physik*, 1933, 84, 367–369).—Spectral selectivity for alloys is additive of the constituent metals.—S. G.

**The Idiosyncracies of Some Modern Alloys.** D. M. Stewardson (*J. Incorporated Brewers' Guild*, 1934, 20, 241–255).—S. G.

\***Applications of the Bloch Theory to the Study of Alloys and of the Properties of Bismuth.** H. Jones (*Proc. Roy. Soc.*, 1934, [A], 147, 396–417).—The Bloch model (*Z. Physik*, 1928, 52, 555) is applied to binary alloys in the  $\epsilon$ - and  $\eta$ -phases and to bismuth and some of its alloys. A qualitative explanation is deduced of the variations of crystal parameters within these phases, and also of the electron-atom ratio at which the  $\epsilon$ -phase begins. A Brillouin zone (see Jones, *Met. Abs.*, 1934, 1, 230) containing five electrons per atom is found for bismuth, and the theory indicates why bismuth does not form a co-ordination lattice. The electrical conductivity of bismuth-tin and bismuth-lead alloys is discussed; the observed variation with composition leads to a determination of the “overlap” of the Fermi surface into the second zone. From this the diamagnetism of pure bismuth and of the alloys are deduced, together with the magnetostriction; good agreement is found between calculated and experimental values.—J. S. G. T.

**Note on the Superconductivity of Alloys.** C. J. Gorter (*Physica*, 1935, 2, 449–452).—[In English.] The remarkable characteristics of many superconducting alloys, e.g.  $\text{Bi}_5\text{Ti}_3$ ,  $\text{PbTi}_2$ , are explainable on the assumption that in a superconducting metal there exist superconducting regions which are smaller

than the depth of penetration of a magnetic field, and that these regions can be stable in magnetic fields above the threshold values of such fields.—J. S. G. 1.

**Magneto-Chemistry.** J. F. Spencer (*Sci. J. Roy. Coll. Sci.*, 1931, 1, 38-49).—Magnetic susceptibility is defined, and the Curie-Cheneveau magnetic balance is described, with some reference to the apparatus of Weiss and Foëx. A description is given of the application of magnetic methods in investigations of the lead-tin, bismuth-tin, lead-silver, lead-gold, and aluminium-tin series of alloys. Measurements of magnetic susceptibility are of service in confirming or disproving the existence of a compound, as in the described case of certain bismuth compounds.—P. M. C. R.

### III—STRUCTURE

(Metallography; Macrography; Crystal Structure.)

(Continued from pp. 585-595.)

**\*Theory and Use of the Metallurgical Polarization Microscope.** Russell W. Dayton (*Trans. Amer. Inst. Min. Met. Eng.*, 1935, 117, 119-150; discussion, 150-155).—See *Met. Abs.*, this vol., p. 156.—S. G.

**More on the Method of Etching Polishing in Metallographic Grinding.** N. M. Zarubin and M. V. Sitin (*Zavodskaja Laboratoria (Works' Lab.)*, 1935, 4, 786-799).—[In Russian.] Discusses the theory and practice of etching and polishing of metal specimens; reagents used in etching of anti-friction alloys, aluminium and copper and their alloys, iron, tantalum, tungsten, molybdenum and hard alloys, and gives photomicrographs of polished surfaces of the above metals and alloys.—D. N. S.

**On Methods for the Metallographic Examination of Hard Alloys (the WC-Fe and Mo<sub>2</sub>C-Fe Systems).** N. M. Zarubin and M. V. Sitin (*Zavodskaja Laboratoria (Works' Lab.)*, 1935, 4, (4), 431-437).—[In Russian.] The best etching reagents for this type of alloy are: (1) a 5% solution of potassium ferricyanide in 5% sodium hydroxide; (2) 2% alcoholic picric acid; (3) 3% alcoholic nitric acid; (4) a mixture of reagents (2) and (3); (5) *aqua regia*; (6) a 7:3 mixture of hydrofluoric and nitric acids. Reagents (1), (2), and (4) are particularly useful for developing the eutectic structure, reagents (1) and (2) for revealing the presence of excess of carbide, reagent (3) for revealing heterogeneity in the solid solution and identifying the eutectic boundaries, and reagent (7) for rapidly attacking the eutectic. Numerous photomicrographs are included to illustrate the properties of the different etching reagents.—D. N. S.

**\*The Facing of Articles by Welding on "Vokar" Alloy.** N. M. Zarubin (*Redkie Metalli (Rare Metals)*, 1935, (5), 48-51).—[In Russian.] Micrographic examination of welded joints between iron and the hard alloy "Vokar" shows the presence of WC but not of W<sub>2</sub>C; the former dissolves to the extent of about 5% in the surface layers of the iron. Subsequent layers become gradually richer in WC and pass through the eutectic composition into the zone of hard alloy free from iron.—D. N. S.

**On Rejections in the Production of Hard Alloys of Metallo-Ceramic Type.** N. M. Zarubin (*Redkie Metalli (Rare Metals)*, 1935, (6), 18-23).—[In Russian.] Examination of the microstructure of hard tungsten carbide alloys prepared in various ways indicated that porosity is due to large grain-size of the tungsten carbide, and to the presence therein of free carbon. Free carbon also reduces the hardness, and shrinkage increases the brittleness and renders the alloys chemically and physically heterogeneous. On the other hand, free tungsten in the carbide or the presence of oxides in the nickel or cobalt "cement" cause cleavage of the alloy. The sintering temperature and the nature of the atmosphere in the furnace also have a considerable influence in presence of oxides on the development of cleavage.—D. N. S.

**\*An Investigation of [Hard] Alloys Prepared by the Sintering Method.** N. M. Zarubin and L. P. Molkov (*Vestnik Metallopromishlennosti (Messenger Metal Ind.)*, 1935, 15, (7), 93-98).—[In Russian.] Micrographic examination of the structure of pseudo-binary alloys of tungsten, molybdenum, tantalum, and titanium carbides with nickel indicates that the solubility of these carbides in nickel is WC 25%, Mo<sub>2</sub>C 12% (eutectic at 30% Mo<sub>2</sub>C), TaC 20% (eutectic at 35-40% TaC), and TiC almost insoluble. X-ray examination of alloys of nickel containing more than 40% TaC (obtained by sintering at 1600°-1650° C.) indicates the formation of a new compound of unknown composition. The paper contains 48 photomicrographs of representative structures.—D. N. S.

**\*Studies upon the Widmanstätten Structure. VII.—The Copper-Silver System.** Charles S. Barrett, Hermann F. Kaiser, and Robert F. Mehl (*Trans. Amer. Inst. Min. Met. Eng.*, 1935, 117, 39-57; discussion, 57-60).—See *Met. Abs.*, this vol., p. 156.—S. G.

**\*Chemical and Physical Properties of Electrolytically Deposited Metals in Relation to Their Structure.** M. Schlötter (*J. Electrodepositors' Tech. Soc.*, 1935, 10, 129-133).—See *Met. Abs.*, this vol., p. 469.—S. G.

**\*Structure and Properties of Nickel Deposited at High Current Densities.** William Blum and Charles Kasper (*J. Electrodepositors' Tech. Soc.*, 1935, 10, 134-142).—See *Met. Abs.*, this vol., p. 287.—S. G.

**\*Influence of Basis Metal on the Structure of Electrodeposits.** A. W. Hother-sall (*J. Electrodepositors' Tech. Soc.*, 1935, 10, 143-149).—See *Met. Abs.*, this vol., p. 286.—S. G.

**\*The Structure of Electrolytic Chromium.** L. Wright, H. Hirst, and J. Riley (*J. Electrodepositors' Tech. Soc.*, 1935, 10, 150-157).—See *Met. Abs.*, this vol., p. 378.—S. G.

**\*Electron Diffraction Examination of Protective Films Deposited on Magnesium and Magnesium Alloys by the R.A.E. Dichromate Process.** H. G. Hopkins (*J. Inst. Metals*, 1935, 57, 227-230).—The protective films, in general, yielded diffuse diffraction rings. It is concluded that the films consist of very small crystals orientated at random. It is tentatively suggested that the diffracting lattice is pseudomorphic magnesium oxide.—H. G. H.

**\*Concerning the Existence of a Transformation which can be Regarded as Accurately of the Second Order.** U. Dehlinger (*Z. physikal. Chem.*, 1934, [B], 27, 112-118).—The nature of transformations of the first, second, and third order, respectively, are briefly discussed. The occurrence of a transformation of the second order in alloys is apparently possible in accordance with the theories of Bragg and Williams, and of Borelius, and has been experimentally realised in the case of the alloy Fe<sub>3</sub>Al. The significance of transformation-hysteresis is briefly discussed.—J. S. G. T.

**Crystallization of Metals from Sparse Assemblages.** E. N. da C. Andrade and J. G. Martindale (*Nature*, 1934, 134, 321-322).—The production of spherulitic particles of gold and silver by slow crystallization from thin films of the metals is described. Spherulitic particles of gold can also be produced by reduction from gold chloride in a silicic acid gel. The mechanism of the production of the particles is discussed.—J. S. G. T.

**The Crystallization of Alloys.** C. H. Desch (*Royal Institution [Lecture]*, 1934, 15 pp.).—The mechanism of crystallization in alloys is described with special reference to steel and the development of Widmanstätten patterns. The age-hardening of Duralumin and beryllium-copper alloys is also briefly discussed.—A. R. P.

**\*Experiments on the Crystallization of Ingots.** R. G. Heggie (*Trans. Faraday Soc.*, 1933, 29, 707-721).—As part of an investigation of the mechanism of crystallization in iron and steel ingots, experiments were carried out with stearic and pure tin, which crystallize in a similar way to pure iron, and on cadmium-tin alloys, which behave like iron-cementite alloys. The results show that



with pure substances columnar crystallization is normal at all cooling rates and that equiaxial crystallization is produced only by some kind of motion or vibration in the metal during solidification. In the case of solid solutions there is a limiting critical cooling rate below which equiaxial crystallization occurs throughout the ingot and above which in still conditions only columnar crystallization occurs; this critical rate is a function of the width of the freezing range and when this is zero only columnar crystallization takes place.—A. R. P.

**\*Recrystallization and Grain-Growth in Cold-Worked Polycrystalline Metals.** L. W. Eastwood, Arthur E. Bousu, and C. T. Eddy (*Trans. Amer. Inst. Min. Met. Eng.*, 1935, 117, 246-264).—See *Met. Abs.*, this vol., p. 587.—S. G.

**Recrystallization Accompanying an Allotropic Change.** C. F. Elam (*Nature*, 1935, 136, 917).—E. refers to the cinematograph record of the  $\alpha \rightleftharpoons \gamma$  change in iron obtained by Burgers and van Amstel (*Nature*, 1935, 136, 721). The photographs show that an allotropic change-point is similar to that occurring on heating cold-worked metal. Reference is made to a method of studying allotropic changes in salts mounted on a microscope slide between crossed nicols and covered with a cover slip. The allotropic change begins at the crystal boundary or round an inclusion or blow-hole.—J. S. G. T.

**Nucleus Formation During Recrystallization.** I. M. Kornfeld (*Physikal. Z. Sowjetunion*, 1935, 7, 432-441).—[In German.] Some degree of precision is given to the ideas of velocity of nuclei formation, recrystallization threshold, and capacity for recrystallization, and the suggested definitions are illustrated by experimental data. The dependence of the velocity of nuclei formation and of the linear rate of growth of new grains on the deformation of the material are briefly discussed.—J. S. G. T.

**\*On the Part Played by Mechanical Twinning in Recrystallization of Deformed Zinc Single Crystals.** V. D. Kuznetsov and V. A. Zolotov (*Zhurnal Eksperimentalnoy i Teoreticheskoy Fiziki (J. Exper. and Theoret. Physics)*, 1935, 5, (1), 75).—[In Russian.] On annealing at 400° C. zinc single crystals, which have been plastically deformed by bending, by indentation with a pointed tool on the basal plane, or by scratching with the tool, recrystallization takes place only in those cases where mechanical twinning has occurred, the twins becoming the nuclei for the generation of new grains. Simple translation cannot cause recrystallization.—N. A.

**\*Centres of Recrystallization in Deformed Zinc Single Crystals.** V. D. Kuznetsov and M. P. Karpov (*Zhurnal Eksperimentalnoy i Teoreticheskoy Fiziki (J. Exper. and Theoret. Physics)*, 1935, 5, (2), 202-208).—[In Russian.] The crystallization nuclei during recrystallization of deformed zinc single crystals are the boundaries of twins, new grains being formed at every twin boundary, after a sufficiently long anneal, but the broader the twin, the shorter will be this period. In the first instance the new crystals appear at the points of intersection of twins of different orientations. All the observed phenomena agree with Alterthum's theory of recrystallization.—N. A.

**\*Distortion of the Space-Lattice of a Zinc Crystal in Mechanical Twinning.** E. S. Jakovleva and M. D. Mochalov (*Zhurnal Tehnicheskoy Fiziki (J. Tech. Physics)*, 1935, 5, (6), 1085-1092).—[In Russian.] Reasons for supposing that distortion of the crystal lattice takes place in twinning are examined. The expected distortions were detected by recrystallization and X-ray methods. The most distorted region of the crystal is at the boundary between the twinned and the original crystal.—N. A.

**\*Nucleus Formation in the Recrystallization Process. I.—Dependence of the Period of Induction on Deformation and Annealing Conditions.** M. O. Kornfeld (*Zhurnal Eksperimentalnoy i Teoreticheskoy Fiziki (J. Exper. and Theoret. Physics)*, 1935, 5, (6), 556-561).—[In Russian.] The following terms are defined and illustrated by examples: rate of formation of nuclei, the threshold of recrystallization, capacity for recrystallization. A relation between the

degree of deformation and the rates of formation of nuclei and of linear growth of new grains has been obtained. The value of the data for elucidating the mechanism of nuclei formation is discussed.—N. A.

**\*On the Kinetics of the Mechanical Twinning of Crystals.** M. Jakutovitch and E. Jakovleva (*Zhurnal Technicheskoy Fiziki (J. Tech. Physics)*, 1935, 5, (7), 1171–1177).—[In Russian.] Deformation of tin, bismuth, or calcite by a ball indentation results in the formation of twinned crystals far beyond the statically stressed area; these twins are cuneiform, the aperture angle increasing with the angle of crystallographic displacement in twinning. The length of the twins is greater for impact than for static deformation; at super-stressed areas (spots of heterogeneous crystal structure) the rate of propagation of twinning in the direction of slip is of the order of the velocity of sound. The energy of the primary twinning impulse is partly dispersed along the lateral boundaries of the twin and partly remains in potential form (distortions of the space lattice) within the region of twinning. With a macrohomogeneous crystal deformation (e.g. elongation) the twinning process is probably similar, since cuneiform twins are also produced.—N. A.

**\*Mechanical Twinning in Bismuth Crystals.** W. F. Berg (*Nature*, 1934, 134, 143).—Single crystals of bismuth exhibit mechanical twinning on the planes of type (110); atoms which formed the (111) planes before twinning occurred, form after twinning, at least partially, the (11 $\bar{1}$ ) plane. In compression tests with bismuth crystals made by the Bridgman method, another kind of mechanical twinning appears. The change in shape and size of the crystal is much bigger than that due to a (110) twin. The comparatively thick twinned lamella lies along one of the (751) planes. The atoms of the (111) planes remain atoms of the (111) plane in the twin. Measurements indicate (751) as the twinning plane. It is remarkable that a plane of so low atomic density can be the twinning plane. Rather large specimens of twins on the (110) planes were observed when a tensile test at higher temperature was applied to a bismuth crystal.—J. S. G. T.

**Twinning at Irrational Surfaces.** D. B. Gogoberidse (*Physikal. Z. Sowjetunion*, 1935, 8, 208–211).—[In German.] The phenomenon of crystal-twinning along irrational surfaces not related to the crystallographic planes, and termed vicinal planes, is discussed with special reference to the work of Brilliantow and Obreimow on the plastic deformation of rock-salt. The phenomenon is met with in metal crystals where it is exhibited in the occurrence of Neumann's lines, and probably occurs as commonly as rational twinning.—J. S. G. T.

**\*Influence of Lattice Distortion on Diffusion in Metals.** Victor G. Mooradian and John T. Norton (*Trans. Amer. Inst. Min. Met. Eng.*, 1935, 117, 89–97; discussion, 97–101).—See *Met. Abs.*, this vol., p. 588.—S. G.

**\*X-Ray Study of Recovery and Recrystallization of Aluminium Single Crystals.** N. Seljakow and E. Sows (*Nature*, 1935, 135, 764–765).—Photographs are given showing the changes taking place in the shape and intensity of the spots of X-ray diffraction patterns when single crystals of aluminium are deformed by extension and are then allowed to recover. The changes are attributed to the removal of stresses and straightening of the elastically-bent separate parts of the deformed single crystal.—J. S. G. T.

**\*X-Ray Examination of Aluminium and Copper Test-Pieces Broken Under Dynamic Forces.** E. Brandenberger (*Schweiz. Archiv angew. Wiss. Tech.*, 1935, 1, 63–66).—Copper and aluminium test-pieces broken dynamically show, qualitatively, similar X-ray characteristics. Both hard and soft varieties were investigated.—W. A. C. N.

**\*Crystallographic Uniformity of Lineage Structure in Copper Single Crystals.** Alden B. Greninger (*Trans. Amer. Inst. Min. Met. Eng.*, 1935, 117, 75–83; discussion, 83–88).—See *Met. Abs.*, this vol., p. 156.—S. G.

**\*An X-Ray Investigation of the Lattice Distortions Produced in Copper by Filing.** G. W. Brindley and F. W. Spiers (*Proc. Leeds Phil. Soc.*, 1935, 3, 4-11).—Cf. *Met. Abs.*, this vol., p. 592. Comparison of the atomic scattering of X-rays by precipitated and filed copper powders shows that filing produces a random displacement of the atoms from the points of the undistorted lattice; the magnitude of the displacement is 0.125 Å. The results obtained also show that the (200) reflections from the filed powders are reduced much more than can be explained in this way; the effect may be connected with the fact that the (100) plane of copper is the slip-plane.—J. S. G. T.

**\*The Texture of Rolled Copper and Nickel.** E. Schmid and F. Staffelbach (*Schweiz. Archiv angew. Wiss. Tech.*, 1935, 1, 221-224).—The texture of cold-rolled copper and nickel sheets was examined by X-ray methods and depicted in polar figures of the cubic and octagonal faces. Contrary to what was found previously, it is shown that also in these cases a single orientation—[101] parallel to the plane of rolling, [112] parallel to the direction of rolling—suffices to determine the diverse crystalline directions, which is a characteristic of face-centred cubic metals. An estimation based on these observations may thus be made of the properties of sheets.—W. A. C. N.

**\*X-Ray [Crystal] Structure Analysis of Crystal Formation in the Ternary System Cu-Al-Ti.** E. F. Bachmetew, N. G. Sevastianow, and N. I. Kotow (*Acta Physicochimica U.R.S.S.*, 1935, 2, 561-566).—[In German.] The existence of two homogeneous phases in the alloy Cu-Al-Ti is established. The one is a cubic structure with  $a = 3.94$  Å. or twice this value; the second is a hexagonal structure with  $a = 5.05$  Å.,  $c = 8.06$  Å.,  $a/c = 0.625$ .—J. S. G. T.

**\*Crystal Formations in "Copper Alutite" [Copper-Aluminium-Titanium] and the X-Ray Analysis of Their Structure (Preliminary Communication).** E. F. Bachmetew, N. G. Sevastianow, and N. I. Kotow (*Zhurnal Fizicheskoy Khimii (J. Phys. Chem.)*, 1935, 6, (5), 593-596).—[In Russian.] See preceding abstract.—N. A.

**\*X-Ray Analysis of the  $\beta$ -Phases of Copper-Beryllium and Aluminium-Zinc Alloys at High Temperatures.** G. F. Kossolapow and A. K. Trapesnikov (*Zhurnal Tehnicheskoy Fiziki (J. Tech. Physics)*, 1935, 5, (3), 407-417).—[In Russian.] See *Met. Abs.*, this vol., p. 157.—N. A.

**\*Lattice Distortion in a Copper-Beryllium Alloy.** G. W. Brindley and F. W. Spiers (*Proc. Leeds Phil. Soc.*, 1935, 3, 73-80).—Intensities of X-ray reflections and atomic scattering factors for a powdered copper-beryllium alloy containing 0.72% by weight of beryllium show that the experimental results are less than calculated values by an amount which increases as the spectrum order increases. This difference is attributed to lattice distortion due to (1) filing, by which the powder was prepared, and (2) the fact that the beryllium atoms in the lattice are smaller than the copper atoms.—J. S. G. T.

**Distortion of the Crystal Lattice of  $\alpha$ -Brass.** W. A. Wood (*Nature*, 1934, 134, 572).—When a metal is cold-worked its X-ray spectrum is found to be modified; the lines become diffuse but the broadening is not symmetrical about the normal position of the line. This is illustrated in the case of  $\alpha$ -brass. Deformation of the metal is accompanied by a change in the average size and shape of the unit cell, and by a change in the latent energy of the crystal lattice. —J. S. G. T.

**\*The X-Ray Study of Indium and the Indium-Silver System.** Ludo K. Frevel and Emil Ott (*J. Amer. Chem. Soc.*, 1935, 57, 228).—A preliminary note. X-ray examination of 99.91% indium showed it to have a face-centred tetragonal lattice  $a = 4.588$ ,  $c = 4.938$  Å. The indium-silver system has three intermediate phases besides the limited range of solid solutions at each end, viz. an indium-rich phase with a complex pseudo-hexagonal close-packed lattice, an indium-rich phase with a face-centred cubic lattice, and a phase inter-



mediate in composition between the last-named and the silver-rich solid solution and having a hexagonal lattice with  $c/a = 1.588$ .—A. R. P.

**\*On the Structure of Liquid Mercury Near the Crystallization Point.** V. J. Donilov and V. E. Neimark (*Zhurnal Eksperimental'noy Teoreticheskoy Fiziki* (*J. Exper. and Theoret. Physics*), 1935, 5, (8), 724–728).—[In Russian.] Liquid mercury at room temperatures has a close-packed structure which, at temperatures near the crystallization point, passes into a different form, resembling the rhombohedral structure of solid mercury.—N. A.

**Lattice Distortion in Nickel-Iron.** W. G. Burgers (*Nature*, 1935, 135, 1037–1038).—It is pointed out that lattice distortion accompanied by changes in the spacings of lattice planes, as found by Wood (*Met. Abs.*, this vol., p. 157) in copper and  $\alpha$ -brass, can be very clearly shown for nickel-iron after rolling.

—J. S. G. T.

**The Spinel and the Cubic Sodium-Tungsten Bronzes as New Examples of Structures with Vacant Lattice Points.** Gunnar Hagg (*Nature*, 1935, 135, 874).—The general formula of the sodium-tungsten bronzes is  $\text{Na}_x\text{WO}_3$ . In the gold yellow bronze,  $x$  is 1 and the cube edge is 3.850 Å. The deepening of colour from yellow through red to blue is accompanied by a continuous decrease in sodium content and lattice dimensions. With decreasing value of  $x$ , vacant points occur in the sodium lattice, and in the blue bronzes ( $x = 0.3\text{--}0.4$ ,  $a = 3.813$  Å.) about  $\frac{2}{3}$  of the original sodium positions are empty. Increasing numbers of  $\text{W}^{+6}$  ions is probably the cause of the deepening of colour.

—J. S. G. T.

**The Fine Structure of the X-Ray Absorption Limits of Alloys. I.— $\gamma$ -Alloys.** R. Smoluchowski (*Z. Physik*, 1935, 94, 775–784).—Cf. *Met. Abs.*, this vol., p. 221. The fine structure of X-ray absorption limits of crystals with complicated lattices and very different numbers of atomic components can be computed by Kronig's theory. Measurements relating to the  $\gamma$ -alloys  $\text{Cu}_5\text{Zn}_8$  and  $\text{Ag}_5\text{Zn}_8$  are here discussed and compared with the very different results given by  $\beta$ -brass.—J. S. G. T.

**\*Note on the Tarnishing of Liquid Metals as Studied by X-Rays.** Hugh O'Neill and G. S. Farnham (*J. Inst. Metals*, 1935, 57, 253–256).—An apparatus was constructed for the X-ray study of liquid metals up to 700° C. by surface reflection. Spectrograms taken with Cu X-radiation in an atmosphere of hydrogen just above the melting point of lead, tin, and SnSb showed the structure of surface tarnish films. Preferred orientation effects were observed. On heating to higher temperatures the tarnish was reduced in thickness, and the Debye ring of the liquid metal replaced the X-ray spectrum of the tarnish.

—H. O'N.

**\*Diffraction of Electrons by Oxide Films on Molten Metals.** J. A. Darbyshire and G. R. Cooper (*Trans. Faraday Soc.*, 1934, 30, 1038–1048).—Examination of the films removed from molten cadmium, magnesium, and aluminium showed a structure agreeing with that found by X-ray examination of the oxides except for certain small discrepancies in the observed intensities of some of the rings. The film on molten aluminium consists of the face-centred cubic ( $\gamma$ )-form of alumina and that on bismuth of face-centred tetragonal bismuth oxide,  $c/a = 1.05$ . The various discrepancies noted in the work indicate that electron-diffraction technique is not yet sufficiently understood to be satisfactorily applied to the examination of all types of thin films.—A. R. P.

**Orientation of Oxide Films on Metals.** Robert F. Mehl, Edward L. McCandless, and Frederick N. Rhines (*Nature*, 1934, 134, 1009).—Fixed orientation relationships have been established for wüstite ("FeO") films grown on iron, and for cuprous oxide films grown on copper. In the case of the former, the respective cube planes are parallel but the cube axes are inclined at 45°. In the latter case the oxide film is formed merely by expansion of the copper lattice without change in orientation; as the film increases in thickness the

perfection of orientation is progressively lost. Even in the thinnest films there is evidence of lattice distortion.—J. S. G. T.

**The Determination of the Properties of Technological Materials from Single Crystal Constants and Crystalline Orientation.** W. Boas (*Schweiz. Arch. angew. Wiss. Tech.*, 1935, 1, 257-264).—B. critically surveys the methods which are used in the calculation of the properties of polycrystalline metals from the behaviour and texture of single crystals. The results are in agreement with observations in the case of quasi-isotropic aggregates and with those for textures which are sufficiently determined by the principal crystallographic positions. If the texture is shown by a polar figure, the properties are determined graphically, e.g. the rolling texture of zinc is amenable to this method.—W. A. C. N.

**\*Determination of Orientations of Metallic Crystals by Means of Back-Reflection Laue Photographs.** Alden B. Greninger (*Trans. Amer. Inst. Min. Met. Eng.*, 1935, 117, 61-71; discussion, 71-74).—See *Met. Abs.*, this vol., p. 157.—S. G.

**The Theoretical Strength of Materials and Their Practical Weakness.** (Sir) William Bragg (*Royal Institution [Lecture]*, 1935, 22 pp.).—The work leading up to the theory of mosaic structure to account for discrepancies between the theoretical and practical strength of materials is briefly outlined.—A. R. P.

**The Universal Meaning of the Cubic Face-Centred Lattice Structure for the Causal Comprehension of Previously Unknown Relationships.** Richard Reinicke (*Z. physikal. Chem.*, 1934, [B], 27, 28-36; *C. Abs.*, 1935, 29, 657).—The fact that most noble metal gases and many metals crystallize in the cubic face-centred crystal lattice suggests that the metals have the crystal lattice of the corresponding noble gas with the valence electrons split off. The rock-salt crystal lattice is also considered as a charged lattice of this sort. The cubic face-centred lattice is then a special case of the rock-salt, the fluorite, and the diamond and zinc-blende type. With these assumptions, conclusions can be reached as to electrical conductivity, superconductivity, electromagnetic induction, photoelectric effect, and mercury vapour rectifiers.—S. G.

**Crystal Classification and Symbolism.** D. Jerome Fisher (*Amer. Mineralogist*, 1935, 20, 292-306).—A classification of crystals according to increasing symmetry is proposed; the systems suggested by Mauguin and by Schoenflies for the symbolism and nomenclature of space and point groups are reviewed, and the general adoption of the Mauguin system is recommended.—P. M. C. R.

**Expression for Determining the Diameter of the Camera from the X-Ray Diagram of a Revolving Crystal.** E. F. Bachmetew (*Zhurnal Tehnicheskoy Fiziki (J. Tech. Physics)*, 1935, 5, 1169-1170).—[In Russian.] An expression is deduced from the distribution of interference maxima.—N. A.

**Doubled Method of X-Ray Structural Analysis.** A. I. Krasnikov (*Zhurnal Eksperimental'noy i Teoreticheskoy Fiziki (J. Exper. and Theoret. Physics)*, 1935, 5, (3-4), 325-329).—[In Russian.] A brief description is given of a method of X-ray analysis using an X-ray tube with a cylindrical anti-cathode, and some results obtained on copper are recorded.—N. A.

#### IV.—CORROSION

(Continued from pp. 595-599.)

**\*The Corrosion of Aluminium.** J. M. Bryan (*Dept. Sci. Indust. Res., Rep. Food Invest. Board 1934, 1935, 187-195; C. Abs.*, 1936, 30, 417).—The corrosion of aluminium by citric acid was studied for 14 days at 25° C. and for 3 days at 75° C. by immersing  $3 \times 1$  in. strips for  $\frac{2}{3}$  of their length in 130 c.c. of solution in the presence of air. Daily readings of gas burettes indicated the type of corrosion and, where necessary, a gas analysis was carried out at the end of

the tests. In the absence of citric acid a 2% NaCl solution and a similar solution containing 25% sucrose had little or no effect in contact with aluminium, either at 25° or at 75° C.; in the presence of acid. NaCl greatly acted as an inhibitor. A purified aluminium (99.5%) corroded more rapidly in 1% citric acid than an ordinary commercial sample (99.2%), and an alloy containing magnesium 3.5, manganese 0.5, and impurities 0.7% corroded at about the same rate as the purified metal; fine abrasion of the surface with emery increased the rate of corrosion about 10–13%. A study of the effects of variation in  $p_H$  at 25° and 75° C. showed that NaCl has a much greater effect at 25° than at 75° C.; at 25° C. the rate of corrosion increased greatly with increase in H-ion concentration, and was mainly of the oxidation type; at 75° C. corrosion was stimulated only below  $p_H$  3.0, there being inhibition at higher  $p_H$  values and the corrosion being mainly of the hydrogen-evolution type over the whole  $p_H$  range. At 25° C., on varying the NaCl concentration from 0 to 3% and keeping the citric acid constant at 0.5%, there was marked stimulation of the H-evolution type of corrosion when the NaCl exceeded about 1%; when the NaCl concentration was kept constant at 1.5% and the citric acid varied from 0 to 2% the H-evolution type of corrosion was practically a linear function of the citric acid concentration. At 75° C. an increase in the amount of NaCl in unbuffered 0.5% citric acid solution greatly increased the rate of corrosion; in solutions buffered to  $p_H$  4.0 with 1.5% of sodium citrate the effect was relatively small, there being a slight retardation of corrosion with less than about 2% NaCl and a slight stimulation at higher concentrations. The relative rates of corrosion of tin and aluminium in citric acid for 3 days at 75° C. were approximately the same for  $p_H$  4–5.5, but below  $p_H$  4 the corrosion of tin was much faster for the limited period, being nearly double that of aluminium at  $p_H$  2.4; the corrosion of the tin was mainly of the oxidative type and would cease when the oxygen was exhausted, while that of the aluminium was of the H-evolution type and would continue until the acid was neutralized. A study of the corrosion of aluminium by *fruit extracts* showed considerable corrosion at 75° C. by gooseberry and black currant, moderate corrosion by greengage, red currant, strawberry, and raspberry, and small or negligible corrosion by cherry and blackberry; at 25° C. corrosion was relatively slow, and little or no  $H_2$  was evolved; the results indicate that factors other than H-ion concentration and total acidity influence the rate of corrosion. From results obtained with blackberries and cherries it seems likely that these fruits tend to form a film on aluminium at 75° C., but this was not sufficiently protective to prevent the formation of hydrogen swells in an actual canning test.—S. G.

\*The Use of Aluminium Cans for Fruits. T. N. Morris and J. M. Bryan (*Dept. Sci. Indust. Res., Rep. Food Invest. Board 1934, 1935, 195–197; C. Abs., 1936, 30, 180*).—Canning tests were carried out on gooseberry, strawberry, raspberry, red currant, black currant, white cherry, and black cherry with plain drawn aluminium cans and also similar cans that were given one coat and two coats of lacquer, respectively. All the plain cans became hydrogen swells in a comparatively short time (many did so in one month). In single-lacquered cans only strawberries have so far (4 months) shown any resistance. The tests in double-lacquered cans have not proceeded for a sufficiently long time for the results to have any value. Success with aluminium cans for fruits which give trouble is likely to be even more dependent on the perfection of the lacquer coating than in the case of tinplate. A comparison of ordinary rolled sheet aluminium and of drawn aluminium showed that the latter was corroded slightly more than the former in 0.5% citric acid, but the difference was not remarkable.—S. G.

Corrosion Research on Light Metals. Freeman Horn (*Proc. Chem. Eng. Group, 1933, 15, 9–17; discussion, 17–20*).—See *Met. Abs. (J. Inst. Metals)*, 1933, 53, 307.—S. G.



**Catalytic Dissolution of Copper in Sulphuric Acid.** M. O. Harmadarian and E. D. Dachniuk (*Zhurnal Prikladnoi Khimii* (*J. Applied Chem.*), 1934, 7, (5), 736-739).—[In Russian.] The effect of various substances on the rate of dissolution of a copper strip in sulphuric acid was examined. Nitric acid markedly increases the rate, but this is mainly due to an oxidation process. Potassium nitrate sharply reduces the rate. With nitrates of metals more electropositive than copper an accelerating effect was expected due to the formation of a metal couple. Magnesium nitrate, however, virtually stopped dissolution altogether owing to the deposition of a dense layer of mercury on to the copper. Silver nitrate, on the other hand, gave a spongy deposit of silver which not only did not impede, but increased the reaction 3-3½ times. Silver nitrate and nitric acid together gave an acceleration different from when the two were added separately. Ferrous sulphide gave an acceleration, but itself dissolved in sulphuric acid evolving hydrogen sulphide. Cobalt sulphide ( $\beta$ -form), which did not dissolve, gave a marked acceleration, but became poisoned after about 10 experiments. It could, however, be revived by working with  $(\text{NH}_4)_2\text{S}$ .—M. Z.

**Corrosion-Resistance of Copper Alloys.** N. W. Mitchell (*Metal Progress*, 1935, 23, (6), 38-41).—The resistance to selective corrosion ("dezincification") to water-line and impingement attack and to intercrystalline corrosion of the various classes of copper alloys is discussed, and the special applications or limitations of each type are indicated.—P. M. C. R.

**\*Comparative Study of the Corrosion Properties of Silicon-Bronzes.** M. Sh. Hashhojeev (*Metallurg* (*Metallurgist*), 1935, (8), 77-89).—[In Russian.] Increase in silicon concentration above 3.5% slightly increases the corrosion in sea-water as also does addition of lead, zinc, iron, or manganese, the three first-named metals being the most harmful. Phosphorus up to 0.24% is without appreciable effect, but aluminium in small quantities increases the corrosion-resistance in sea-water. The best copper alloys for use in sea-water or superheated steam are the 1:8 iron-aluminium alloy, the 0.64:2.78:11.9 aluminium-silicon-zinc alloy, and manganese-brasses of the usual composition. —N. A.

**\*Corrosion Tests Regarding Gothenburg's Tap-Water.** Klas Söndén (*Tek. Tid. Uppl. C, Kemi*, 1932, 62, 33-36, 41-46; *C. Abs.*, 1932, 28, 6040).—The corrosion of copper, lead, zinc, tin, and forged and cast iron by hot and cold tap-water from two sources in Gothenburg was investigated. The tests were carried out with (1) untreated water, (2) water treated with limestone, and (3) water treated with slaked lime. The results show that the corrosion of copper and lead offers the safest means of comparing two kinds of water. The attack by the water on copper, lead, zinc, and tin was reduced considerably by the neutralization of the carbon dioxide. The carbon dioxide is apparently of minor importance in the corrosion of iron, as in some cases it was stronger in treated than in untreated water. If the filtration of water through limestone was allowed to proceed slowly, this method was found equally effective as the slaked lime method, and had advantages over this method in requiring less complicated apparatus and being simpler to control. Subsequent treatment with slaked lime did not further improve the water. The testing methods are described in detail and the apparatus is illustrated.—S. G.

**The Corrosion of Lead in Buildings.** F. L. Brady (*Dept. Sci. Indust. Res., Building Res. Tech. Paper No. 8*, 1934, 26 pp.).—A revised edition of a report published in 1929. Information is given regarding the causes and prevention of corrosion of lead by cements and mortars, timber, and soil. It is shown that lime solutions remove the protective films formed on lead in the air, so that when placed in contact with lime or Portland cement mortar in conditions such that infiltration of water takes place, the metal is continuously converted to lead oxide. When the water entering the mortar contains dissolved oxygen,

the lead is subjected to the simultaneous action of moisture, oxygen, and lime. This process ceases when the lime or cement mortar is carbonated. High-alumina cement is less corrosive than Portland cement. Corrosion by timber may be rapid when lead is in contact with oak or other hard woods. The decay is ascribed to the action of acids in the timber acting in conjunction with moisture and atmospheric oxygen and carbon dioxide. Soft woods cause less decay of lead than oak, but there is appreciable action. It is not considered advisable to recommend the general adoption of any practice for preventing the corrosion of lead by soil. To avoid probable trouble, pipes may be laid in chalk, limestone, or old, well-carbonated lime mortar, or the pipes may be bagged with felt strips impregnated with bitumen. The substitution for lead of suitable lead alloys, such as antimony-lead or tin-lead, is sometimes advisable.—S. G.

**Action of Inorganic Acids on Lead.** Jacques Mahul (*Indust. chimique*, 1934, 20, 892-894).—A review of recent literature.—S. G.

**\*Corrosion Below Discontinuous Oxide Coatings, with Special Reference to Magnesium.** K. G. Lewis and U. R. Evans (*J. Inst. Metals*, 1935, 57, 231-248; discussion, 248-252).—Protective processes fall into 2 classes: (a) safe processes, where even incomplete treatment lengthens the time of perforation; (b) dangerous processes, where inadequate treatment intensifies attack and brings quicker perforation than no treatment. Magnesium, uncoated and coated with oxide layers produced by 3 different treatments applied for numerous different periods, was subjected to sodium chloride in a new circulating apparatus. Time-corrosion curves and perforation periods have been obtained. The data show that these processes belong to the "safe" class.—K. G. L.

**\*Corrosion of Magnesium Alloys. V.—The Influence of Manganese on the Corrosion of Magnesium.** W. O. Kroenig and S. E. Pavlov (*Trans. Res. Inst. Aircraft Materials (U.S.S.R.)*, 1935, (30), 34 pp.).—[In Russian, with English summary.] See abstract from German source, *Met. Abs.*, this vol., p. 60.—S. G.

**\*Velocity of Dissolution of Metals in Aqueous Salt Solutions. VI.—Dissolution of Tin in Aqueous Ferric Chloride.** E. Bekier, W. Łukaszewicz, and F. Wejcówna (*Roczniki Chemji*, 1934, 14, 1479-1487; *Brit. Chem. Abs.*, 1935, [A], 454).—The dissolution of tin in aqueous ferric chloride containing hydrochloric acid involves the reactions:  $\text{Sn} + 2\text{FeCl}_3 \longrightarrow \text{SnCl}_2 + 2\text{FeCl}_2$ ;  $\text{SnCl}_2 + 2\text{FeCl}_3 \longrightarrow \text{SnCl}_4 + 2\text{FeCl}_2$ ;  $\text{Sn} + \text{SnCl}_4 \longrightarrow 2\text{SnCl}_2$ . The velocity of dissolution is given by  $-v \cdot dx/dt = s[k_1(a-x) + k_2x]$ , where  $v$  is the volume of the solution,  $s$  the tin surface ( $\text{cm}^2$ ),  $a$  the initial  $\text{FeCl}_3$  concentration, and  $x$  the fraction of  $\text{FeCl}_3$  reduced at time  $t$ . The temperature coeff. of the const.  $k$  is 1.24.—S. G.

**\*The Corrosion of Tin.** J. M. Bryan (*Dept. Sci. Indust. Res., Rep. Food Invest. Board 1934, 1935*, 177-179; *C. Abs.*, 1936, 30, 419).—Experiments were carried out to ascertain the effects of sodium chloride and sucrose, respectively, on the rates of corrosion of tin by solutions of citric acid at 25° and 75° C. in presence of a limited amount of air. Addition of 2% sodium chloride had a slight inhibiting effect on corrosion, which was more pronounced on untreated specimens than on those whose surfaces had been abraded with fine emery. Addition of 1% sodium chloride to a 0.5% citric acid solution of  $p_H$  2.4 at 25° C. had no effect, but as the  $p_H$  increased to 5.5 (by addition of sodium citrate buffer) there was a slight increasing inhibiting effect. Addition of 25% sucrose at 25° C. produced an appreciable inhibition over the whole  $p_H$  range studied, the rate of corrosion being reduced to  $\frac{1}{3}$  at  $p_H$  2.4 and to  $\frac{1}{5}$  at  $p_H$  5.5. At 25° C., addition of varying amounts of sucrose to 0.5% citric acid solution progressively retarded the rate of corrosion as the concentration increased. This inhibition seems to be due mainly to the effect of sugar in reducing the solubility of air in the solutions, since the corrosion (like that in plain citric acid solutions) was entirely of the oxidative type. At 75° C., concentrations of less than 15% sucrose inhibited corrosion, while greater concentrations stimulated it; the

latter effect, however, may have been due to the action of one or more of the decomposition products formed by caramelization. Addition of antimony to the tin produced a small reduction in corrosion, amounting to 8% with 0.25% antimony and to 11% with 0.5%; larger additions did not give further reduction.—S. G.

**\*Corrosion of Steel and Tinplate by Actual Extracts of Fruits.** T. N. Morris (*Dept. Sci. Indust. Res., Rep. Food Invest. Board 1934, 1935, 180–183; C. Abs., 1936, 30, 180*).—Steel strips  $3 \times 1$  in. were immersed for 3 days at  $25^{\circ}\text{C}$ . in sterile extracts of various fruits. The  $p_{\text{H}}$  values of the extracts were measured, the loss in weight of the strips and c.c. of hydrogen produced were determined, and the theoretical hydrogen was calculated from the loss in weight. The most noteworthy results were: (1) although of relatively low acidity, cherry extract of  $p_{\text{H}}$  3.1 formed a bronze-coloured deposit which stopped further corrosion, and when buffered with sodium citrate to  $p_{\text{H}}$  4.07 it formed a loose yellow deposit which was non-protective; (2) there appears to be a fairly close correlation between corrosion and the rate of formation of hydrogen swells and perforations by the various fruits tested. Addition of citric acid to cherry extract reduces corrosion; addition of 25% sucrose to the extract slightly reduces corrosion over the whole  $p_{\text{H}}$  range, but the reduction through the addition of acid was of about the same order, whether sugar was present or not. Strips of tinplate  $3 \times 1$  in. were rubbed with emery to remove the tin longitudinally from half the surface, and were immersed in fruit extracts like the plain steel strips. The figures for dissolved iron indicate the fruits which may be expected to give trouble through the formation of hydrogen swells, and those for dissolved tin indicate those fruits which either suffer severely from discoloration or cause heavy detinning of the cans. On the whole, fruits producing high corrosion of tin produce low corrosion of iron, and *vice versa*.—S. G.

**\*Survey of the Inhibiting Properties of English Beet Sugars [on Acid Corrosion of Cans].** T. N. Morris (*Dept. Sci. Indust. Res., Rep. Food Invest. Board 1934, 1935, 183–185; C. Abs., 1936, 30, 637*).—Samples of beet sugars, including some brown unrefined sugars and molasses, were tested against a standard pure cane sugar and a specially pure commercial cane sugar. It was shown that the inhibiting property is generally distributed in beet sugars and is particularly abundant in beet molasses and brown beet sugars. Various kinds of fruit were packed in double-lacquered cans with (a) a pure white sugar possessing neither inhibiting nor accelerating properties and (b) 3 parts of the same sugar mixed with 1 part of brown beet sugar possessing strong inhibiting properties. The cans were examined periodically for hydrogen-swells and perforations. In every case (except one where the loss due to swelling had attained serious dimensions) there was an advantage in using the sugar which definitely contained an inhibitor to acid corrosion.—S. G.

**\*The Use of Sodium Sulphite as an Addition to Alkaline Detergents for Tinned Ware.** R. Kerr (*J. Soc. Chem. Ind., 1935, 54, 217–221r; and Tech. Publ. Internat. Tin Res. Develop. Council, 1935, [A], (19), 12 pp.*).—The corrosion of tin and tinned copper in hot sodium carbonate and sodium hydroxide solutions is mainly controlled by the concentration of dissolved oxygen, and only to a slight extent by temperature and concentration of alkali. By addition of sodium sulphite to the alkaline solution the rate of attack of tin may be reduced to about one tenth; the mechanism appears to consist in the removal of the dissolved oxygen. For detergents used in the dairy and other industries it is recommended to add 1 part of sodium sulphite to 10 parts of crystallized sodium carbonate.—E. S. H.

**\*The Rate of Dissolution of Zinc in Acids.** Cecil V. King and Morris Schack (*J. Amer. Chem. Soc., 1935, 57, 1212–1217*).—The rate of dissolution of rotating zinc cylinders in acetic and hydrochloric acids of varying concentration in the presence of oxidizing agents (depolarizers) such as *paranitrophenol*, potassium nitrate, hydrogen peroxide, and quinone was determined and the results are



shown in a series of tables and graphs. The effects of high concentrations of sodium acetate and sodium chloride on the dissolution of zinc and magnesium in acetic acid were also examined. In general, the curves indicate that corrosion is controlled by diffusion of the oxidizing agent with a constant acid concentration, and of the acid at a constant low concentration of oxidizing agent.

—A. R. P.

**Reduction of Corrosion Losses Due to Selection of Equipment.** W. F. Rogers (*Oil and Gas J.*, 1935, 33, (46), 84; *J. Inst. Petrol. Tech.*, 1935, 21, 190A).—Special attention is necessary to the problem of the rapid rate of corrosion experienced by equipment used in the production of oil. A detailed study has been made of the subject in order to develop means by which the corrosivity of a well fluid could be determined accurately, and to evaluate the various materials which are offered for corrosion-resistant equipment. The corrosivity of an oil-field brine can be determined to only a very small degree through analysis of the brine. It is still necessary initially to equip each well with the usual type of materials and to wait for the corrosivity of the fluid to become obvious. Developments of corrosion-resistant materials has made it possible to select equipment which can be used to reduce the costs experienced when non-corrosive resistant equipment is used.—S. G.

**\*Corrosion from Products of Combustion of Gas. II.—Tube Experiments.** Joint Research Committee of the Institution of Gas Engineers and Leeds University (*Inst. Gas Eng. Communication No. 100*, 1934, 47 pp.; *Build. Sci. Abs.*, 1934, 7).—In a study of the behaviour of metals when exposed to the action of the products of combustion of coal-gas, metal tubes were surrounded by water-jackets maintained at 40°–60° F. (4°–16° C.) whereby 80–95% of the water produced by combustion of the gas was condensed on their inner surfaces, this, together with the sulphur and nitrogen acids dissolved therein, forming a corrosion medium. The investigation is described in full. The results show that the metals may be divided into 3 groups, showing good, medium, and poor resistance to attack as follows: (1) lead, tin, solder; (2) aluminium, chromium plate, nickel plate, brass; (3) iron, zinc.—S. G.

**Corrosion of Metals by Phosphoric Acid.** F. A. Rohrman (*Chem. and Met. Eng.*, 1935, 42, 368–369).—Production of orthophosphoric acid and of orthophosphates is complicated because of the corrosion difficulties, attributable chiefly to impurities in the raw material (phosphate rock). The presence of fluorides and sulphates in the acid renders it more corrosive, although some sulphuric acid aids in protecting lead, owing to the formation of insoluble lead sulphate. The results of a recent investigation show that of over 80 alloys, the following gave the highest corrosion-resistance at 95° C., viz. high-chromium irons (chromium > 27%), nickel-chromium-molybdenum steels, high chromium, low nickel irons (chromium > 27%; nickel 3%) high nickel-chromium alloys of the Ilium type, Hastelloys C and D. At 20° C. the best results were obtained from all the above-mentioned, together with all stabilized 18–8 alloys, Duriron and Durichlor, Elcomet L, Inconel, Hytenzyl bronze, lead and antimonial lead, and chromium-nickel-iron alloys (chromium > 22%, nickel > 10%). No metal or alloy has been found to resist the acid completely. Large quantities of lead have been used, but its use is limited if the fluoride content is high and the SO<sub>3</sub> content of the solution is low.—F. J.

**\*Effect of Excess Lime Hydrate on Corrosive Soft Water.** Frank E. Hale (*J. Amer. Water Works Assoc.*, 1935, 27, 1199–1224).—See *Met. Abs.*, this vol., p. 518.—J. C. C.

**The Corrosion of Metals by Milk.** C. G. Fink and Fr. A. Rohrman (*Lait*, 1934, 14, 1060–1068).—S. G.

**\*The Control of Corrosion in Air-Conditioning Equipment by Chemical Methods.** C. M. Sterne (*Proc. Amer. Soc. Test. Mat.*, 1935, 35, (II), 261–270; discussion, 271–274).—See *Met. Abs.*, this vol., p. 347.—S. G.

**The Corrosion of Metals.** U. R. Evans (*Science Progress*, 1935, 29, 395-408).—A review, with numerous references.—S. G.

**Mechanism of Dissolution of Metals.** M. Centnerszwer and W. Heller (*Roczniki Chemji*, 1934, 14, 525-559; *Brit. Chem. Abs.*, 1935, [A], 308).—A description is given of the methods involved in the study of the kinetics of dissolution of metals, and the nature of the processes taking place is discussed on the basis of a comprehensive survey of the literature.—S. G.

**\*Investigation of the Process of Mutual Displacement of Metals.** N. Isgarischev and I. Mirkin (*Obshchey Khimii* (*J. General Chem.*), 1934, 4, 982-987).—[In Russian.] See abstract from German source, *Met. Abs.*, 1934, 1, 588.—S. G.

**†Questions of the Replacement of Metals and the Struggle Against Corrosion in Mechanical Engineering.** S. E. Noskov (*Vestnik Metallopromishlennosti* (*Messenger Metal Ind.*), 1935, 15, (3), 121-131; (4), 150-159; (5), 116-132).—[In Russian.] A detailed review.—D. N. S.

**Corrosion-Resisting Non-Ferrous Alloys.** H. Moore and E. A. G. Liddiard (*Chem. and Ind.*, 1935, 54, 786-795; and (summary) *Light Metals Rev.*, 1935, 1, 400-402).—A review of published work, especially with regard to alloys of aluminium, copper, lead, nickel, tin, zinc, and magnesium. The effects of composition, structure, surface condition, and stress are discussed.—E. S. H.

**Non-Corroding Alloys.** P. Bastien (*Pratique Indust. mécaniques*, 1935, 18, (2), 41-50).—A classification of corrosion-resistant metals and alloys is followed by a brief survey of common types of corrosive attack. Resistant ferrous and non-ferrous materials are then considered in some detail: the latter class includes certain bronzes, nickel, the cupro-nickels, nickel-chromium, and Monel metal. A section is devoted to the light and ultra-light alloys; materials resisting attack by such special media as nitric acid, hydrogen sulphide, petrol, saline solutions, hydrofluoric acid, and alkalis are noted, and additional methods of protection are indicated.—P. M. C. R.

**Alloys that Resist Severe Corrosive Conditions.** H. L. R. Whitney (*Chem. and Met. Eng.*, 1935, 42, 370-371).—The considerations governing the choice of corrosion-resistant materials in the petroleum, chemical, and food industries are discussed. Only corrosion-resistant steels are mentioned.—F. J.

**Ferrous and Non-Ferrous Alloys Classified by Composition.** Max. A. Shaffer (*Chem. and Met. Eng.*, 1935, 42, 383-386).—A classified list of corrosion-resistant metals and alloys, with, in most cases, their proprietary or trade names.—F. J.

**Errors in Corrosion Research.** R. B. Mears and H. E. Daniels (*Trans. Electrochem. Soc.*, 1935, 68, 375-384; discussion, 384-390).—See *Met. Abs.*, this vol., p. 518.—S. G.

**\*The "Probability" of Corrosion.** R. B. Mears and U. R. Evans (*Trans. Faraday Soc.*, 1935, 31, 527-542).—Measurements were made of the influence of 16 external variables on the probability and the conditional velocity of corrosion by drops using various iron and steel specimens. The probability is depressed but the conditional velocity increased by oxygen concentration and by the presence of some inhibitors. Previous exposure to oxygen depresses the probability of attack by dilute sodium bicarbonate but not by certain other solutions. Rise in temperature of the corrosive medium and the presence of sulphur dioxide increase the probability of corrosion, whereas the presence of carbon dioxide stimulates the conditional velocity. Owing to their mutual protective effect, the presence of neighbouring corroding points depresses the probability. From data connecting probability and oxygen-concentration it appears that the pores grow continuously more frequent as the size is reduced indicating that the film has essentially a porous character like that produced by iodine on silver.—A. R. P.

**Corrosion Testing Methods.** H. E. Searle and F. L. La Que (*Proc. Amer. Soc. Test. Mat.*, 1935, 35, (II), 249-260).—See *Met. Abs.*, this vol., p. 347.—S. G.

**Simple Device Gauges Corrosion.** H. E. Searle and F. L. La Que (*Inco*, 1935, 13, (1), 11-12).—See *Met. Abs.*, this vol., p. 347.—R. G.

**An Ammeter for Corrosion Currents.** — (*A. E. G. Progress*, 1935, (4), 58-59).—The presence, strength, and direction of stray currents in cable-sheaths can be observed and measured by the ammeter described, without the necessity for moving or uncovering the cable. The currents to be measured induce a change of frequency in the a.c. circuits of the ammeter, the construction of which is described.—P. M. C. R.

## V.—PROTECTION

(Other than Electrodeposition.)

(Continued from pp. 599-605.)

**Protection and Decoration of Aluminium and Its Alloys by Anodic Oxidation.** J. Bally and A. Dumas (*Rev. Aluminium*, 1935, 12, 2983-3008).—The general principles of intensive oxidation, the general character of anodic oxidation processes, and the preparation and suspension of articles to be submitted to the processes are discussed. The Bengough, Eloxal, and Alumilite processes are described in some detail. The applications of anodic oxidation include simple protection against corrosion, support for varnish or paint, electrical insulation, resistance to abrasion, and direct tinting.—J. H. W.

**\*On the Regulation of the Bath Solution (Oxalic Acid Aqueous Solution) for the Electrolytic Oxidation of Aluminium.** Akira Miyata and Motoyuki Takei (*Rikwagaku Kenkyū-jo Iho* (Bull. Inst. Phys. Chem. Res. Tokyo), 1934, 13, 1285-1298; *C. Abs.*, 1935, 29, 6148).—[In Japanese.] The amounts of oxalic acid to be added to correct for deterioration of electrolyte were determined. For 2% solution  $w = 2.0 - 0.361p + 0.546p^2 - 0.08707p^3$  (where  $w = [\text{H}^+]$  after replenishing, in grm. of oxalic acid per 100 c.c.,  $p = [\text{C}_2\text{O}_4^{--}] - [\text{H}^+]$  in grm./100 c.c.). The values of  $p$  and  $[\text{H}^+]$  are determined by titration;  $w$  can then be calculated, and an amount of acid  $w - [\text{H}^+]$  added. For 3 and 4% solutions,  $w = 3.0 - 0.823p + 0.784p^2 - 0.1187p^3$ , and  $w = 4.0 - 0.556p + 0.718p^2 - 0.1146p^3$ , respectively.—S. G.

**\*Inactive State Due to the Formation of Anodic Film of Aluminium, and Its Application to the Prevention of Corrosion.** Akira Miyata (*Rikwagaku Kenkyū-jo Iho* (Bull. Inst. Phys. Chem. Res. Tokyo), 1934, 13, 1299-1327; *C. Abs.*, 1935, 29, 6195).—[In Japanese.] On being dipped into alkali and heated in high-pressure steam, aluminium develops an inactive surface of crystalline  $\text{Al}_2\text{O}_3 \cdot \text{H}_2\text{O}$ , which withstands the attack of alkali and organic acids and is superior to the film of the ordinary anodic process. The treatment is best applied after the formation of a thick anodic film.—S. G.

**\*Conditions Governing the Formation of Highly Insulating Anodic Layers on Aluminium.** J. E. Lilienfeld, J. K. Nieh, and G. Goldman (*Trans. Electrochem. Soc.*, 1935, 68, 533-546; discussion, 546-547).—See *Met. Abs.*, this vol., p. 519.—S. G.

**The Surface Treatment of Aluminium and Aluminium Alloys.** H. Krause (*Light Metals Rev.*, 1936, 2, 240-241).—Summarized from *Illust. Zeit. Blech-industrie*, 1935, 64, 968; see *Met. Abs.*, this vol., p. 519.—L. A. O.

**Aluminium Plating.** H. G. Heine (*Light Metals Rev.*, 1935, 2, (10), 161-163; and *Aluminium and Non-Ferrous Rev.*, 1935, 1, 85-86).—Translations from *Aluminium*, 1935, 17, 467-476; see *Met. Abs.*, this vol., p. 520.—J. C. C.

**\*The Protection of Magnesium Alloys Against Corrosion.** H. Sutton and L. F. Le Brocq (*J. Inst. Metals*, 1935, 57, 199-220; discussion, 220-226).—Short-time chromate treatments of magnesium-rich alloys of two types in common use were investigated, and the protective value of the treatments was compared with the 6-hr. chromate treatment and other forms of protective



treatment. A bath was evolved capable of giving good films in 30–45 minutes, and suitable for use in steel or aluminium tanks. The protective value of the 6-hr. and short-time chromate treatments, with and without supplementary coatings of varnishes and enamels, was investigated with reference to typical alloys. Intermittent sea-water spray laboratory tests and beach exposure tests were carried out, and the corrosion which occurred was observed by loss of weight and change in mechanical properties. Experiments were carried out on the influence of cleaning treatments employed before chromate treatment.—H. S.

**\*Application of Calorized Refining Pipe-Still Tubes.** C. L. Clark, Roger Stewart Brown, and A. E. White (*Oil and Gas J.*, 1935, **33**, (45), 44–45, 129).—The Calorizing of ferrous materials, as originally applied, resulted in the production of a thin aluminium coating, liable to brittleness and to become detached from the basis material owing to the presence of an intermediate layer of FeAl. A subsequent heat-treatment of the pieces permits the aluminium to penetrate into the ferrous base to a considerable depth, and hence, by decreasing the concentration of aluminium in the coating, increases the strength and elasticity of the latter. The modified process has been applied to a variety of steels, and the results of creep tests, ordinary tensile testing, scratch hardness tests, and exposure to oxidation and to hydrogen sulphide corrosion are tabulated. They indicate that the properties of comparatively inexpensive carbon steels are so improved by Calorizing that these materials can safely be substituted for "special" steels in many types of oil-refinery fitting. The results of service tests support this view.—P. M. C. R.

**\*Improvement in the Quality of Tinplate by Superimposed Electrodeposition of Tin.** (Hothersall and Bradshaw.) See p. 702.

**\*Examination of the Surface of Tinplate by an Optical Method.** W. E. Hoare and Bruce Chalmers (*J. Iron Steel Inst.*, 1935, **132**, 135–142; and (summary) *Iron Coal Trades Rev.*, 1935, **131**, 429–430).—See *Met. Abs.*, this vol., p. 520.—S. G.

**The Variation of Substance in Tinplates.** J. Selwyn Caswell (*Proc. S. Wales Inst. Eng.*, 1935, **50**, 339–403; and *Iron and Coal Trades Rev.*, 1934, **129**, 715–716).—S. G.

**Tin as an Anti-Corrosion Coating.** Bruce W. Gonser (*Food Ind.*, 1935, **7**, 585).—S. G.

**Modern Methods of Preventing the Oxidation of Metals.** G. de Lattre (*Pratique Indust. mécaniques*, 1935, **18**, 81–88, 209–213).—The methods considered include (1) galvanization: suitable plating and cleaning conditions are discussed in connection with iron and copper bases, and the influence of aluminium, tin, antimony, and cadmium on working temperature and on the properties of the deposit are discussed and tabulated; (2) tinning; (3) "cementation," or the bonding of electrodeposits to the basis metal by heating; (4) oxidation processes; (5) plating by rolling together appropriate protective and basis materials; (6) treatment with saline solutions; (7) painting.—P. M. C. R.

**Preventing Corrosion in the Rayon Plant.** Theodore R. Olive (*Textile World*, 1932, **82**, 530–532).—Briefly discusses methods for preventing corrosion of plant during manufacture of rayon.—S. G.

**Recent Developments in the Manufacture of Sucker Rods.** Blaine B. Westcott and L. W. Vollmer (*Oil and Gas J.*, 1934, **33**, (22), 36–40).—Developments in the design of sucker rods for oil drilling are described and illustrated. Whilst modern practice favours the use of alloy steels, galvanizing and cadmium plating have afforded satisfactory protection against corrosion where the conditions are not too severe, and a lead coating, applied by plating or dipping, should constitute an excellent protective against acid and/or sulphur corrosion if complete continuity could be ensured. The use of copper-clad rods as box and pin forgings is likely to prove unduly costly.—P. M. C. R.

**Protective Films on Ferrous Alloys. Influence of Chloride Ion on Electromotive Behaviour.** Florence Fenwick (*Indust. and Eng. Chem.*, 1935, 27, 1095–1099).—A rapid, reliable method of comparison of the effectiveness of protective films on structural metals is desirable. The method described is essentially an electrometric titration wherein a chloride solution is slowly added to the solution in which the metal is immersed; this metal, with its film or coating, acts as one electrode, and the other is a suitable standard electrode appropriately connected. The sudden unmistakable change in the observed potential marks an abrupt change in the character of the surface of the electrode. The evidence presented indicates a general parallelism between the relative amount of chloride required to bring about a breakdown of the film on ferrous materials and general experience as to the relative resistance to atmospheric corrosion of 3 types of ferrous alloy, *viz.* plain carbon steels, copper-bearing steels, and stainless steels.—F. J.

**Cladding of Ferrous Products. A New Electrochemical Method.** Raymond R. Rogers (*Indust. and Eng. Chem.*, 1935, 27, 783–789).—The coating or “cladding” of a metal such as steel with a material of greater resistance to corrosion, heat, or abrasion formerly consisted (1) in welding the 2 materials together by hammering, rolling, or pressing under the action of heat (known as the all-assembly method) or (2) in placing 2 sheets of the “cladding” material (separated by a layer of asbestos) in an ingot mould and pouring molten steel round them, followed by separating into 2 parts and hot-rolling separately. R. describes a new method which eliminates the effects of oxide films in preventing uniform adhesion between “cladding” material and backing, effects which were present in the older methods. All non-metallic films on the “cladding” material are removed by anodic pickling in dilute hydrochloric acid, and, before a new non-metallic film can form, a layer of iron is electro-deposited on the clean pickled surfaces. This composite material is then clad on to ferrous material such as mild steel by either of the methods (1) and (2) above mentioned. In addition to stainless irons and steels, &c., nickel and Stellite can be satisfactorily clad on to ordinary mild steel. Photomicrographs illustrate the effectiveness of the new method and the absence of non-metallic inclusions either between the “cladding” materials and the electrodeposit of iron or between the latter and the backing (mild steel).—F. J.

**Anhydrous Ammonia Used in Refining.** E. R. Woodward (*Oil and Gas J.*, 1934, 33, (17), 33–39).—A survey of the development of anti-corrosion measures in oil refineries leads to the use of ammonia in combating corrosion by hydrochloric acid or by sulphur dioxide in refinery plant. The methods for effecting and controlling the introduction of ammonia are described, and the correct  $p_H$  value for use with Admiralty metal and other copper-bearing alloys is discussed. Attack on these by ammonia can be obviated by adequate control.—P. M. C. R.

**\*Cementation of Iron and Ferrous Alloys by Beryllium.—I.—III.** J. Laissus (*Rev. Mét.*, 1935, 32, 293–301, 351–360, 401–422).—(I.—) Previous work is reviewed and reference is made to the work of other investigators on the *iron-beryllium system*. L. gives a plan of his work. (II.—) Diffusion experiments with electrolytic iron and carbon steels at temperatures in the range 800°–1100° C. and in periods of 2–10 hrs. are described. (III.—) Cementation experiments are described in which iron and carbon steels were treated in ferro-beryllium (80% beryllium) in the range 800°–1050° C. The properties of the cemented layers were examined for hardness, influence on oxidation at elevated temperatures, and resistance to corrosion. L. considers that Oesterheld's diagram for the *iron-beryllium system* is incorrect but adopts that of Wever and Müller. The solid solubility of beryllium in iron is limited, and beyond this point a eutectic of  $\alpha$  iron-beryllium solid solution and the compound  $FeBe_2$  appears. In the cemented layers, the following can be seen in

succession: (1) solid solution zone, (2) hypo-eutectic zone, (3) eutectic zone; solid solution and compound. In carbon steels, there is also a zone of successive decarburization. The superficial hardness of iron and steels is increased substantially by the cementation, values as high as 1500 Vickers being obtained on a eutectoid steel. The resistance of iron and steel to oxidation at elevated temperatures is much improved by the cementation. Resistance to corrosion is also increased appreciably for water, sea-water, and salt-spray, but reduced for many acids and chlorinated solutions.—H. S.

**\*Metallic Cementation. II.—Metallic Cementation [of Copper] by Means of Tin Powder. III.—Metallic Cementation [of Nickel] by Tin Powder.** Tsutomu Kase (*Kinzoku no Kenkyu*, 1935, 12, 257–266, 301–308).—[In Japanese.] See *Met. Abs.*, this vol., p. 385. The cementation of copper (pp. 257–266) and nickel (pp. 301–308) by tin was investigated. No English summaries are given of these sections of the work.—S. G.

**\*Investigation of the Schoop Metal-Spraying Process.** Hans Ulrich Thor-mann (*Dissertation Badischen Tech. Hochschule*, 1933, pp. 78).—The object of the research was the discovery of the relationships between the variables encountered in metal spraying by the wire pistol. The theory of metal spraying, as advanced by previous writers, is described. The hardness of sprayed metal coatings of iron, copper, aluminium, and Monel metal was measured: it is reduced as the temperature of the base metal is increased and is also reduced with increasing nozzle distance until a certain standard hardness is reached. The hardness increases with the speed of the wire feed and with increasing oxygen pressure. With increase of hydrogen pressure there is also a slight increase in hardness, and increase of air pressure also tends to increase hardness. A table gives the most suitable conditions of working to attain high hardness values. The wear of sprayed coatings was tested in a machine designed by Schmidt. Wear increases as the temperature of the object sprayed increases, but decreases with increasing nozzle distance, and with higher wire speeds. Wear also increases with higher oxygen and hydrogen pressures, but decreases with higher air pressures. The density of sprayed coatings is reduced by increasing the temperature of the object sprayed and by increasing the wire feed, oxygen pressure, or hydrogen pressure. When spraying iron, the density increases up to a nozzle distance of 20 cm.; with the other metals no such increase is noted. The adherence of sprayed metal coatings is discussed. Adhesion is reduced by increasing nozzle distance and by reducing the feed of wire; it is also reduced by increasing hydrogen pressure and by increasing the air pressure. A table shows the settings of the pistol which give the best adhesion. The coeff. of expansion of sprayed coatings decreases with increasing nozzle distance, but increases with accelerated feed; a marked increase is also noted with increased air pressure. The efficiency of metal spraying decreases with increasing nozzle distance, but is increased by accelerated wire feed. A table shows the settings of the pistol to give the highest efficiency. The filling of blow-holes by means of metal spraying is discussed. A bibliography of previous work on metal spraying is appended.—W. E. B.

**Experience in Germany Proves that Metals can be made Heat-Resistant by Spraying with Aluminium.** C. H. Daeschle (*Metallizer*, 1934, 2, (4), 2, 3).—A method is described for treating steel objects by aluminium spraying and afterwards heating under a flux consisting of sodium chloride, potassium chloride, lithium chloride, and sodium fluoride, namely "Cryolite."—W. E. B.

**Marine Applications [of Metal Spraying].** John G. Hammond (*Metallizer*, 1935, 3, (10), 7, 14).—A description of work carried out on the linings of Diesel marine motors. Corroded parts were filled with steel by the metal-spraying process and, after spraying with steel, the surface is sprayed with cadmium to prevent further corrosion.—W. E. B.



**Improved Lining for New Refinery Vessels [by Metal Spraying].** L. E. Kunkler (*Metallizer*, 1935, 3, (5), 2, 3, 8).—A description is given of tests on steel plates which were sprayed with aluminium and finally heat-treated at 1100° F., after covering with water-glass. The coatings had good resistance to sulphuric acid and other reagents, and it is suggested that they could be used with success in oil refineries.—W. E. B.

**Some Good Jobs Around a Refinery [with Metal Spraying].** H. R. Leland (*Metallizer*, 1935, 3, (5), 4, 5).—A description of successful work carried out by the metallizing process in connection with heat exchanger baffles, intake chambers, radiant tube headers, &c.—W. E. B.

**[Metal Spraying] Four Successful Jobs.** H. R. Leland (*Metallizer*, 1934, 2, (4), 4, 5).—A description of the successful metallizing with aluminium of radiant tubes in an oil refinery, and the metallizing with lead of a 17-ft. agitator.—W. E. B.

**Submarine Battery Chambers Are Protected [by Metal Spraying].** S. John Oechsle (*Metallizer*, 1935, 3, (10), 4).—A description of the lead coating, by metal spraying, of tanks for submarines: details are given of how the work was carried out.—W. E. B.

**Metallizing in Ice and Refrigeration Plants.** V. A. Cook (*Metallizer*, 1935, 3, (10), 2, 3).—The protection of brine tanks and ice cans and condensers of refrigerating plants is described. Zinc coatings are used in most cases, 0.006 in. thick.—W. E. B.

**Boyden Explains the Mechanical Features of Metal Spray Equipment.** Charles Boyden (*Metallizer*, 1934, 2, (4), 10, 11, 12).—A full description of the power unit and nozzle of the metal-spraying gun, and a discussion of the factors which influence their design.—W. E. B.

**Cold-Spraying with Aluminium.** O. Kühner (*Z.V.d.I.*, 1936, 15, 132).—See *Met. Abs.*, this vol., p. 386.—K. S.

**The Mellozing Metal-Spraying Process.** — (*Engineering*, 1935, 140, 704).—A distinctive feature of this process is that the metal or alloy to be sprayed is first melted in a gas-fired crucible and maintained molten in the pistol by a Bunsen-type burner.—R. Gr.

**Protecting Floating Roofs of Oil Tanks [by Metal Spraying].—II.** R. A. Axline (*Metallizer*, 1935, 4, (1), 9–10).—See also *Met. Abs.*, this vol., p. 603. A second Inspection Report of a test on floating roofs of oil tanks where parts of the roof were sprayed with such metals as aluminium, cadmium, lead, and zinc. This second inspection indicates that sprayed lead of at least 0.020 in. in thickness is a suitable metal for protecting such roofs.—W. E. B.

**Metallizing in Prevention of Corrosion in Refineries.** H. R. Leland (*Oil and Gas J.*, 1935, 33, (45), 99).—See *Met. Abs.*, this vol., p. 604.—S. G.

**Resurfacing of Corroded and Worn Equipment at Refineries Found Practical and Economical.** H. R. Leland (*Oil and Gas J.*, 1934, 32, (48), 36, 44).—The protection of oil-refinery gear by sprayed metal coatings is described. Aluminium has been used with success in the interior of coke chambers, and the method has been applied to the building-up of worn parts. Lead is used for the protection of tanks for acid treatment.—P. M. C. R.

**Spraying Liquid Metal to Decrease Corrosion.** Robert E. Kunkler (*Metallizer*, 1935, 4, (1), 6–8, 13).—See also *Met. Abs.*, this vol., p. 602. K. deals with the use of aluminium coatings for the protection of those parts of oil-refining plant which come in contact with hydrogen sulphide. It is claimed that aluminium gives very good protection against this gas.—W. E. B.

**Application of Schoop's [Metal Spraying] Process in Shipbuilding.** N. A. Krisov (*Sudostroenie (Shipbuilding)*, 1935, (3), 63–66).—[In Russian.] The Schoop metal-spraying process is examined from the point of view of density of the coating, its uniformity, consumption and losses of zinc, costs and uses, on the basis of experience at the Baltic yard.—N. A.

**Metal Spraying in Marine Construction.** P. Humann (*Werft, Reederei, Hafen*, 1935, 16, (3), 40-42).—Boiler tubes, superheater parts, and their supporting members may be protected effectively against high-temperature attack by Alumatizing, a process of aluminium coating which is briefly described. Tests show an increase in tensile strength and a slightly decreased elongation in treated material. An analogous process, Leukotizing, is used for the production of a firmly adherent coating of cadmium, which is recommended for the protection of hulls from marine growths and for application to tail-shafts. For the latter purpose a Leukotized coating is said to have superior properties to one of hard rubber. Bronze spraying is recommended for the protection of propeller blades.—P. M. C. R.

**Protective Metallic Coatings by Wire-Spraying Process.** W. E. Ballard (*Indoxco*, 1935, 1, (2), 16-19, 21).—Read before the Manchester Association of Engineers. See *Met. Abs.*, this vol., p. 522.—W. E. B.

**Paints for Water Tank Interiors.** H. N. Bassett (*Railway Engineer*, 1935, 55, 405-406).—Aluminium varnish applied over a chromate priming containing a flexible vehicle was the only coating which successfully resisted the action of stored water containing either combined chlorine or combined chlorine together with caustic soda in 30-day immersion tests for 8-hr. periods at temperatures of 170° and 120° F. (77° and 49° C.) Further tests made in the interior of a water tank and continuing for about 18 months showed that aluminium powder in an elastic waterproof (synthetic) resin vehicle, thinned with mineral naphtha, formed one of the most reliable protective coatings. Aluminium pigment was also the most successful among those used in a linseed-oil vehicle, which was, however, generally inferior to synthetic resin.—P. M. C. R.

**The Duraspray Rust-Proofing Process.** — (*Engineering*, 1935, 140, 456).—A wet priming coat of red-lead paint is dry-sprayed with finely-divided metallic powder, consisting of specially prepared zinc dust containing a certain proportion of aluminium.—R. Gr.

## VI.—ELECTRODEPOSITION

(Continued from pp. 605-608.)

**\*Investigation of the Structure and Qualities of Electrolytic Deposits. II.—Influence of the Conditions of Chromium Plating on the Porosity of the Deposits.** V. I. Arharov and U. B. Fedorov (*Zhurnal Tekhnicheskoy Fiziki (J. Tech. Physics)*, 1935, 5, (4), 718-720).—[In Russian.] Cf. *Met. Abs.*, this vol., p. 235. Tests with a bath containing chromic acid 150 and sulphuric acid 1.5 grm./litre showed that porosity increased with increase in current density between 20 and 100 amp./dm.<sup>2</sup> and decreased with increase in bath temperature from 30° to 80° C.—N. A.

**\*Studies in the Theory of Chromium Electrodeposition.** Raymond R. Rogers (*Trans. Electrochem. Soc.*, 1935, 68, 391-412; discussion, 412-415).—See *Met. Abs.*, this vol., p. 299.—S. G.

**Chromium-Plated Screen Plates.** D. H. Bissell and R. E. Cleveland (*Paper Mill*, 1932, 55, (36), 4).—The chromium plating of plates for pulp and paper screens is described.—S. G.

**\*Concentrated Copper Cyanide Plating Baths.** L. C. Pan (*Trans. Electrochem. Soc.*, 1935, 68, 471-481; discussion, 481-482; and *Met. Ind. (Lond.)*, 1935, 47, 471-474).—See *Met. Abs.*, this vol., p. 525.—S. G.

**How Attractive Finish Helps Metal Productions Sales. 23.—Copper Plating.** Marshall G. Whitfield (*Iron Age*, 1934, 134, (4), 27-29).—The method of electroplating copper on steel and the applications of the copper-plated steel are described. A comparison of this material with other coatings is given.

—J. H. W.

**Electrolytic Nickel Deposits in Decoration.** Marcel Ballay (*Rev. Nickel*, 1934, 5, 52–64).—Methods for testing the adherence, thickness, porosity, and regularity of distribution of nickel plate are described, and numerous examples of the use of nickel and nickel–chromium plating in the arts and in industry are illustrated. An appendix contains standard American and French specifications for nickel plate and standard tests for quality.—A. R. P.

**\*Inorganic Addition Salts in the Nickel Plating Solution.** Russel Harr (*Trans. Electrochem. Soc.*, 1935, 68, 425–444; discussion, 444–448).—See *Met. Abs.*, this vol., p. 525.—S. G.

**\*The Effect of Oxidizing Agents on Nickel Deposition. I.—Hydrogen Peroxide and Nickel Nitrate.** A. W. Hotherhall and R. A. F. Hammond (*J. Electrodepositors' Tech. Soc.*, 1935, 10, 13–28).—See *Met. Abs.*, this vol., p. 22.—S. G.

**\*On the Simultaneous Discharge of Nickel and Hydrogen Ions from the Solutions of Simple Nickel Salts.** O. Essin and E. Alfinowa (*Trans. Electrochem. Soc.*, 1935, 68, 417–424).—The application of the equation for the simultaneous discharge of two ions to the experimental data on the deposition of nickel and hydrogen from solutions of single salts was checked, using data already in the literature and additional data obtained in this investigation. It was found that the calculated current efficiency values agree satisfactorily with empirical values within a wide range of conditions: nickel ion concentration from 0.5N to 3N; hydrogen ion concentration from almost neutral to 0.5N; cathode current density from 0.5 to 10 amp./dm.<sup>2</sup>, and electrolyte temperature from 16° to 90° C. It was also found that the calculated current efficiency values are a function of the cathode voltage and nickel and hydrogen ion concentrations. This is in accordance with the deduction of the equation of simultaneous discharge as based on Volmer's theory. Finally, it was found that the value of the proportionality factor,  $\gamma$ , for nickel is equal to 0.39, while the corresponding value for hydrogen was assumed by Volmer to be equal to 0.5.—S. G.

**Testing the Quality of Nickel Deposits.** J. Pospíšil (*Chem. Listy*, 1932, 26, 287–289; *C. Abs.*, 1932, 26, 5852).—Nickel-plated copper articles are immersed in the solution ( $K_3Fe(CN)_6$  5 grm.,  $KMnO_4$  5 grm.,  $HgSO_4$  1 grm., conc.  $H_2SO_4$  10 c.c.,  $H_2O$  1 litre) for a few seconds, withdrawn, and observed for 1–2 minutes. Defective areas in the nickel layer deposit mercury, copper going into solution to form  $Cu_2Fe(CN)_6$ . These defective spots become red-brown, while the solution over the nickel remains yellow. This solution is not suitable for brass-plated articles. Nickel-plated brass articles are immersed for 1 minute in a solution containing  $K_3Fe(CN)_6$  5 grm.,  $K_2Cr_2O_7$  5 grm., KI 1 grm.,  $HgCl_2$  1 grm., conc.  $HCl$  150 c.c.,  $H_2O$  1 litre. This solution is quite stable. On a copper base the solution produces red-brown spots, but the greatest sensitivity is on a brass base.—S. G.

**Electrodeposition of Niobium.** N. A. Isgarischev and G. E. Kaplan (*Obshchey Khimii* (*J. General Chem.*), 1934, 4, 1415–1421; *Brit. Chem. Abs.*, 1935, [A], 711).—[In Russian.] Cf. *Met. Abs.*, 1934, 1, 187. During electrolysis of solutions containing niobium and tantalum, part of the niobium is deposited as a bright, adherent coating on the cathode, an equal amount undergoes precipitation from the electrolyte, whilst the greater part is converted into a non-electrolytic form, not precipitated by tannin. Tantalum is not deposited.—S. G.

**Electrodeposition of Tantalum.** N. A. Isgarischev and A. F. Prede (*Obshchey Khimii* (*J. General Chem.*), 1934, 4, 1422–1427; *Brit. Chem. Abs.*, 1935, [A], 711).—[In Russian.] Cf. *Met. Abs.*, 1934, 1, 389. Tantalum is electrodeposited on copper cathodes from solutions at 70°–80° C., containing 50% of resorcinol; deposition commences 1 hr. after the passage of current, and does not take place when the anolyte and catholyte are separated by a diaphragm, pointing to the existence of a preparatory process in the



anolyte. Satisfactory deposition is not obtained when a number of substances are substituted for resorcinol.—S. G.

**\*The Electrodeposition of Tin and Its Alloys. I.—The Effect of Addition Agents on the Deposition of Tin from Alkaline Stannate Baths.** Lawrence E. Stout and August Erspamer (*Trans. Electrochem. Soc.*, 1935, 68, 483–491; discussion, 491–492).—See *Met. Abs.*, this vol., p. 526.—S. G.

**\*Improvement in the Quality of Tinplate by Superimposed Electrodeposition of Tin.** A. W. Hothersall and W. N. Bradshaw (*J. Soc. Chem. Ind.*, 1935, 54, 320–326r; and *Tech. Publ. Internat. Tin Res. Develop. Council*, 1935, [A], (22), 16 pp.).—Small thicknesses of electrodeposited tin reduce, and larger amounts eliminate, the porosity of tin coatings on tinplate, provided that the electrodeposit is from an alkaline solution; acid tin baths are not effective. The resistance of the composite coatings to corrosion in outdoor atmospheres is superior to that of hot-dipped coatings of equal thickness. The process imparts a spangled, iridescent appearance to the tinplate, which can be either accentuated for decorative purposes by slight etching before plating, or can be removed by light polishing. Severe local porosity produced by bending tinplate can be removed by electrodeposition of tin on the bent tinplate.

—E. S. H.

**\*Control of the Quality of Electrodeposited Tin Coatings.** J. L. Vertsman (*Zavodskaja Laboratoria (Works' Lab.)*, 1935, 4, (7), 757–759).—[In Russian.] The thickness and uniformity of the coating is ascertained by placing a drop of 1:3 nitric acid on the surface for 15 seconds, rinsing it off and replacing it with a second drop; the procedure is repeated until the surface of the base metal is reached. The number of drops required is proportional to the thickness of the coating.—D. N. S.

**\*Experiments in the Production of Coloured Films on Metals by Electroplating.** P. N. Petrov and S. M. Borozdina (*Vestnik Elektromishlennosti (Messenger Elect. Ind.)*, 1935, (7), 37–38).—[In Russian.] On electrolysis of ammonium molybdate solutions a lustrous black cathodic deposit is obtained which is, however, very brittle. Addition of ammonium molybdate to cyanide plating baths containing copper and zinc affords pure green deposits with a slight olive tint which have a fair resistance to corrosion. The nature of the cathode has no influence on the colour or quality of the deposit. A suitable bath contains copper sulphate crystals 60, zinc sulphate crystals 45, ammonium molybdate 30, sodium bisulphite 3–4.5, and free potassium cyanide 6–8 gm./litre; it is operated at 0.2–0.4 amp./dm.<sup>2</sup> at up to 2.5 v. at room temperature.

—N. A.

**Electro-Plating Installation at a Sheffield Works.** — (*Engineering*, 1935, 140, 659).—A brief description of a plant for the deposition of silver, nickel, copper, cadmium, and chromium.—R. Gr.

**Cathode Film Control and Metal Deposition.** Colin G. Fink (*J. Chem. Education*, 1935, 12, 520–524).—Edgar Fahs Smith Memorial Address to the University of Pennsylvania. See *Met. Abs.*, this vol., p. 608.—J. H. W.

## VII.—ELECTROMETALLURGY AND ELECTROCHEMISTRY (Other than Electrodeposition.)

(Continued from pp. 608–609.)

**Recent Progress in Industrial Electrochemistry and Electrometallurgy.** A. Clergeot (*Technique moderne*, 1934, 26, 373–378).—An illustrated description is given of the electrolytic production of magnesium, and brief mention is made of that of aluminium and beryllium; a list of other metals obtained by similar means is appended. The position of the electrolytic refining of copper in the U.S.A. and in France is reviewed, and an account is given of the principal

raw materials and their sources. The methods employed in the electrolytic refining of silver, gold, zinc, cadmium, and tin are summarized. In a review of the (cold) chromium plating process, C. discusses the optimum thickness of deposit; the hardness obtained by this method is adequate for ornamental purposes, but to obtain a hard-wearing deposit the hot process must be employed.—P. M. C. R.

**\*Formation of Alloys from Galvanic Elements.** V. A. Plotnikov and D. P. Zosimovitch (*Mem. Inst. Chem. All-Ukrain. Acad. Sci.*, 1934, 1, 170-184).—[In Russian, with German summary.] See *Met. Abs.*, this vol., p. 608.—S. G.

**Production of Ferro-Alloys Directly from Minerals in the Electric Arc Furnace.** Alfred Salmony-Karsten (*Quim. e Ind.*, 1935, 12, 231-235; *C. Abs.*, 1936, 30, 963).—Briefly describes some large commercial installations for the production of ferro-silicon, ferro-manganese, ferro-chromium, ferro-molybdenum, and ferro-tungsten.—S. G.

**Direct Production of Silumin and Aluminosilicon in Works' Electrolytic Baths.** A. I. Zheleznov and B. N. Maksimenko (*Legkie Metalli (Light Metals)*, 1935, (2), 32-46).—[In Russian.] Silumin may be made directly by adding silico-aluminium (an alloy of silicon 77, aluminium 16, and iron 1.5% produced by electrothermal reduction of alumina by coke and silicon) to baths from which aluminium is being obtained by electrolysis, the additions being made, after anode "flashings," during the first 18 hrs. of the 24 hrs. before pouring. After tapping off the alloy the bath is operated for 48 hrs. before further addition of silico-aluminium. An alloy containing up to 16% silicon, was obtained; attempts to produce alloys of higher silicon content resulted in the increased dissolution of silicon in the electrolyte, a reduction in the efficiency of the bath due to secondary reactions, and a decrease in the recovery of silicon in the alloy. In obtaining the 16% silicon alloy the output of the bath (alumina reduced) and the consumption of raw material are unchanged, except for an increased consumption of 10-20 kg. of fluoride per ton of aluminium.—D. N. S.

**\*The Electrolytic Production of Lead-Copper Alloys from Benzenedisulphonic Acid Electrolytes.** P. P. Belaiew, A. G. Valejeva, and S. P. Gelman (*Vestnik Metallopromishlennosti (Messenger Metal Ind.)*, 1935, 15, (6), 117-124).—[In Russian.] The influence of the relative and absolute concentrations of lead and copper salts and of free benzenedisulphonic acid and the effects of current density on the course of the electrolysis have been studied, using iron cathodes and copper-lead alloy anodes. With a copper-lead ratio of 4:1 nearly pure copper is deposited on the cathode. With a 1:4 ratio the cathode deposit contains 2-6% copper. With an equimolecular concentration of lead and copper salts, the cathode deposit contains from 5.3 to 80% of lead as the cathode current density is raised from 0.25 to 8 amp./dm.<sup>2</sup>. The optimum composition of the electrolyte is 0.5*N* with respect to the salt of each metal, 0.1*N* with respect to free acid, but the latter may be reduced to 0.04*N* without appreciably affecting the composition of the alloy. Deposits containing 20-30% lead resist corrosion in water and in 5-95% sulphuric acid at 18° and 50° C., are relatively insoluble in alkalis and in dilute hydrochloric acid, and are non-porous when the thickness exceeds 2-3  $\mu$ .—D. N. S.

**\*The Electrochemical Behaviour of Lead, Lead-Antimony, and Lead-Calcium Alloys in Storage Cells.** H. E. Haring and U. R. Thomas (*Trans. Electrochem. Soc.*, 1935, 68, 293-307, and *Bell Telephone System Tech. Publ., Chemistry, Monograph B-883*, 1935, 15 pp.).—See *Met. Abs.*, this vol., p. 528.—S. G.

**\*Alkali Amalgam Electrodes and Their Use with Colloid Solutions.** Z. J. Berestnewa and V. A. Kargin (*Acta Physicochimica U.R.S.S.*, 1935, 2, 151-162).—[In German.] Values of the potentials of amalgams of sodium and potassium in sodium chloride solutions of strengths 1.0-0.01*N* and in 0.1-0.001*N*

potassium chloride solutions were measured. Alkali amalgam electrodes become poisoned by products of hydrolysis when arsenious oxide is present in the electrolyte.—J. S. G. T.

**\*Use of the Barium Amalgam Electrode for the Determination of the Activity of Barium Ions in Aqueous Solutions.** Z. J. Berestnewa and V. A. Kargin (*Acta Physicochimica U.R.S.S.*, 1935, 2, 163-170).—[In German.] A barium amalgam electrode is described. Values of its potential against barium chloride solutions of strengths 1.0-0.001N were determined. Sodium ions present to the extent of a concentration 9.1N in the solution of barium chloride do not affect the value of the electrode potential. Application of the electrode to determine the activity of barium ions in aqueous solutions is described.—J. S. G. T.

**\*The Influence of H.F. Currents on Polarized Electrodes.**—II. S. Glasstone and G. D. Reynolds (*Trans. Faraday Soc.*, 1933, 29, 399-409).—Cf. *Met. Abs.* (J. *Inst. Metals*), 1933, 53, 32.—Experiments with platinum electrodes in solutions containing various oxidizing agents indicate that the beneficial effects of a superimposed high-frequency current on the limiting current for 100% electrode efficiency are due to an increase in the rate of diffusion of the depolarizer and are independent of the surface tension of the electrolyte. Increase in temperature or stirring decreases the effect as also does addition of neutral salts.—A. R. P.

**\*(1) Electrode Potentials of Sodium and Potassium in Liquid Ammonia. (2) Electrode Potentials in Water and in Liquid Ammonia.** W. A. Pleskow and A. M. Monosohn (*Acta Physicochimica U.R.S.S.*, 1935, 2, 615-620, 621-632).—[In German.] (1) Values of the normal potentials of sodium and potassium electrodes in liquid ammonia are determined. The respective values found at  $-50^{\circ}\text{C}$ . are  $E_{Na} = 2.174\text{ v.}$ ;  $E_K = -2.316\text{ v.}$  Contrary to results with all other elements, the values are greater algebraically than the values found for these two electrodes in water, and approach more nearly to the value of the hydrogen electrode in the respective liquids. (2) Values of the potential of a dropping mercury electrode in solutions of ammonium nitrate, liquid ammonia, and aqueous ammonia solutions are determined. Values of the electrode potentials of potassium, sodium, zinc, cadmium, lead, hydrogen, copper, silver, and mercury in liquid ammonia relative to the potential of the hydrogen electrode in water are calculated. The results are discussed in terms of theories of solvation and hydration.—J. S. G. T.

**\*Electrode Potentials [of Zinc, Cadmium, Lead, Copper, Silver, and Mercury] in Liquid Ammonia.** W. A. Pleskow and A. M. Monosohn (*Acta Physicochimica U.R.S.S.*, 1935, 1, 871-882).—[In German.] Values of the normal potentials of zinc, cadmium, lead, hydrogen, copper, silver, and mercury electrodes in liquid ammonia were determined as follows: zinc,  $-0.848_5\text{ v.}$ ; cadmium,  $-0.510_6\text{ v.}$ ; lead,  $0\text{ v.}$ ; hydrogen,  $0.331_6\text{ v.}$ ; copper,  $0.103_3\text{ v.}$ ; silver,  $0.472_5\text{ v.}$ ; mercury,  $0.414_0\text{ v.}$ —J. S. G. T.

## VIII.—REFINING

(Continued from pp. 609-610.)

**\*A New Method of Extracting Gases from Metals.** Léon Moreau, Georges Chaudron, and Albert Portevin (*Compt. rend.*, 1935, 201, 212-214).—The method consists of placing the specimen in a vacuum discharge tube and making it the cathode. The potential between the terminals can be increased to 150,000 v. With a current of 5 milliamp., the cathode does not get hot, extraction occurring in the cold. The discharge tube is connected to a Langmuir pump in series with a head of mercury. The mechanism of the rapid extraction can be explained by the surface molecules being ionized and drawn



into the electric field, replacement being effected by diffusion in the metal. Several separations with intervals of rest of about 24 hrs. are necessary with specimens of the order of 1 mm. thickness. Diffusion can be accelerated by warming, and a single operation will then be effective for a thickness of several millimetres. The results of extraction by this and by other methods are compared for aluminium and cadmium containing nitrogen. The new method allows selective separation of gases, such as carbon dioxide, nitrogen, carbon monoxide, and hydrogen.—J. H. W.

**A New Method of Extraction of Gases in Metals.** — (*Metallurgist* (Suppt. to *Engineer*), 1935, 10, 71).—A review of a paper by Moreau, Chaudron, and Portevin (preceding abstract). It is suggested that although the method described may yield surprising results, the source of the large volume of gas disclosed (compared with that shown by the ordinary vacuum method) must be established as due to the specimen by full investigation.—R. G.

## IX.—ANALYSIS

(Continued from pp. 610-616.)

**The Rôle of the Spectrograph and of Minor Elements in Die-Castings.** Thomas A. Wright (*Trans. Amer. Inst. Min. Met. Eng.*, 1935, 117, 329-337).—See *Met. Abs.*, this vol., p. 352.—S. G.

**Methods of Quantitative X-Ray Analysis.** N. D. Borisov and P. L. Kisel'gof (*Zavodskaja Laboratoria* (Works' Lab.), 1935, 4, 800-804).—[In Russian.] A review.—D. N. S.

**Arrangement for Quantitative Spectral Analysis.** Henri Triché (*Compt. rend.*, 1935, 200, 1538-1541; *C. Abs.*, 1935, 29, 4283).—To determine the amount of a metal  $M$  in an alloy  $A_1$ , vertical plates of the alloy and of another  $A_2$  containing a known amount of  $M$  are arranged one above the other with a plate  $A_3$  of metal (or metals) not present in  $A_1$  or  $A_2$ , placed horizontally between them. With a suitable p.d., sparks pass between  $A_1$  and  $A_3$ , and  $A_3$  and  $A_2$ , whereby a suitable spectral line in the two sparks can readily be compared in intensity by means of a suitable arrangement of lenses, &c. Provided that the proportion of the ingredients is not very different, the amounts of  $M$  present are proportional to the intensities of the selected line.—S. G.

**Quantitative Analysis of Non-Ferrous Alloys by Spectroscopic Methods.** R. A. Wolfe (*Proc. Amer. Soc. Test. Mat.*, 1935, 35, (II), 87-92; discussion, 93-98; and *Met. Ind. (Lond.)*, 1935, 47, 633-635).—The method described is similar to that used by Owens and Hess (*Met. Abs.*, this vol., p. 707); an outline of its application to the determination of Al, Ba, and Cr in Ni alloys and of Mg in Zn alloys is given.—A. R. P.

**The Purification of Graphite Electrodes for Spectrochemical Analysis.** G. W. Standen and L. Kovach, Jr. (*Proc. Amer. Soc. Test. Mat.*, 1935, 35, (II), 79-85; discussion, 86).—Two methods are described: (1) the electrodes are boiled in *aqua regia* for 2 hrs., well washed with distilled  $H_2O$ , soaked in  $NH_4OH$  for 2-3 hrs. at  $50^\circ C$ ., dried, and heated in  $NH_3$  gas at  $1000^\circ C$ . for 15 minutes, then in  $Cl_2$  for 23 hrs.; (2) the electrodes are boiled with glacial  $CH_3CO_2H$  after the *aqua regia* and  $NH_4OH$  treatments as in (1), washed, boiled in  $H_2O$ , digested with hot  $NH_4OH$ , and dried. Finally the purified electrodes are burned in an arc of 10-15 amp. for  $1\frac{1}{2}$  minutes.—A. R. P.

**Automatic Measurement, Reduction, and Recording of Wave-Lengths from Spectrograms.** George R. Harrison (*J. Opt. Soc. Amer.*, 1935, 25, (6), 169-178).—A device is described which can be attached to any standard moving-plate comparator which automatically records the passage of the density

maximum of a spectrum line, computes the wave-length corresponding to this maximum and records this value to 8 figures photographically at high speed. When measuring a plate, the operator sees on a screen before him a magnified image of a portion of the spectrum; the light in this image actuates an amplifier system through 3 photo-cells to give records of plate density and rate of change of density with distance. When the density slope becomes zero while the density is greater than some predetermined background value a mercury arc flashes to record the wave-length dial readings. Correct wave-length readings for any desired number of standard lines can be set into the machine, or an empirical dispersion formula can be introduced.—R. G.

**\*Method of Quantitative Spectrographic Analysis of Aluminium.** A. P. Striganov (*Zhurnal Tekhnicheskoy Fiziki* (*J. Tech. Physics*), 1935, 5, (7), 1145-1157).—[In Russian.] Tables are given for determining 0.05-1.0% Fe or Si, 0.01-0.2% Cu, Mn, or Mg, and 0.02-1% Zn in Al. The lines used for comparison are usually those of Al itself, but for Zn, the Cu spectrum is used as an auxiliary, the "coupling" pair being  $\lambda$  Al 2669.2 Å. and  $\lambda$  Cu 2824.4 Å. For Si and Cu, tables are given based on the same auxiliary spectrum but using  $\lambda$  Al 3050.1 Å. and  $\lambda$  Cu 2961.6 Å. The line pair  $\lambda$  Cu I 2492.2 Å. and  $\lambda$  Cu II 2489.6 Å. are used for controlling the electrical conditions. The mean variation from the results of chemical analysis is less than 10%.—N. A.

**Spectrographic Determination of Impurities in Commercial Cadmium.** Frances W. Lamb (*Proc. Amer. Soc. Test. Mat.*, 1935, 35, (II), 71-78).—The method described depends on the use of standard solutions containing Cd and known amounts of impurity (Zn, Fe, Pb, Cu, Ni, Ti). The lower graphite electrode (positive) being impregnated with the solution, and an arc of 11 amp. at 220 v. being passed between the two electrodes. A series of spectrograms using various solutions and the unknown solution is taken on the same plate and the % of impurity in the latter determined by the comparison method.—A. R. P.

**\*Study of Quantitative Spectral Analysis.**—II. R. Breckpot and A. Mevis (*Ann. Soc. Sci. Bruxelles*, 1934, [B], 54, 99-119).—Cf. *Met. Abs.*, this vol., p. 389. Tables of data regarding the persistence of the most important lines used in quantitative spectral analysis are given for Cd, Sn, Zn, Al, Ba, Ca, Mg, Ge, and Au. Small additions of compounds of these elements were made to copper oxide and the investigation was carried out on the mixtures thus obtained. The results are therefore applicable to the determination of these elements as impurities in Cu.—C. E. H.

**\*The Spectrographic Estimation of Some Secondary Constituents in Copper.** Raymond Breckpot (*Ann. Soc. Sci. Bruxelles*, 1933, [B], 53, 219-247).—As a result of a detailed investigation, using a number of different comparison rays, it is found that the minimum quantities of Pt, Bi, Ag, Sb, and As which can be spectrographically determined in copper are 0.001, 0.0001, 0.0001, 0.01, and 0.01%, respectively. The carbon arc was used as a means of excitation.—C. E. H.

**\*The Spectrographic Determination of Traces of Germanium.** Application to Metallic Copper and Iron. R. Breckpot (*Ann. Soc. Sci. Bruxelles*, 1935, [B], 55, 160-173).—An investigation of a method of determining Ge in which the latter is distilled off in the form of the volatile chloride. The Ge is precipitated from the latter as sulphide in the presence of a little Cu which collects the precipitate. The precipitate is examined spectrographically. The distillation of the germanium chloride is effected by passing a stream of  $\text{Cl}_2$  either through a boiling HCl solution of the original sample, or over the solid metal. The latter is more suitable when a large amount of the sample has to be taken, but owing to the large amount of copper chloride carried over, a wet distillation is often necessary afterwards. By either modification  $10^{-3}$ - $10^{-7}$ % Ge may be estimated in Cu.—C. E. H.

**\*Spectrographic Determination of Traces of Bismuth, Arsenic, Antimony, Tin, and Lead in Electrolytic Copper.** R. Breckpot (*Ann. Soc. Sci. Bruxelles*, 1935, [B], 55, 173–194).—The spectrographic determination is carried out on CuO containing oxides of the impurities, instead of on the original metal, as in this way more representative results are obtained. It is found that the concentration of the impurities in the oxide mixture may be made greater than in the original metal, by occlusion with  $\text{Fe}(\text{OH})_3$  during precipitation. The Cu is occluded to a much smaller extent than the other metals, and by suitable procedure its occlusion may be rendered negligible. As a result of the concentration of the impurities they may be estimated in proportions as small as  $10^{-5}$ – $10^{-6}$  %.—C. E. H.

**Quantitative X-Ray Spectral Analysis of Copper and Zinc Alloys.** VI. Karchagin and V. Tolmachev (*Zhurnal Eksperimental'noy i Teoreticheskoy Fiziki (J. Exper. and Theoret. Physics)*, 1935, 5, (2), 183–191).—[In Russian.] With a Zeeman spectrograph and Philip's tube with an Fe anti-cathode Cu absorption spectra were obtained by placing Cu and Zn alloy plates 0.04 mm. thick in the path of the rays. From microphotograms of these spectra it was possible to determine, by Glocker and Fronmeyer's methods, the Cu content in five alloys with Zn. The results show that this method can be used for alloys of two elements, such as Cu and Zn, which are adjacent in the Periodic Table, the probable errors being no greater than those of Glocker and Fronmeyer.—N. A.

**Quantitative Spectrographic Analysis of Magnesium Alloys for Manganese and Silicon.** J. S. Owens and T. M. Hess (*Proc. Amer. Soc. Test. Mat.*, 1935, 35, (II), 61–67; discussion, 68–70; and *Met. Ind. (Lond.)*, 1936, 48, 38–40).—Determinations of Mn (0.009–1.5%) and of Si (0.005–2%) in Mg can be made accurately by the spectrographic method employing a condensed spark discharge between solid alloy electrodes and using the Mg lines 2915.5 Å. and 3074.1 Å. as internal standard. The logarithms of the relative intensities of these lines and of the Mn lines 2607.7 and 2949.2 Å., or the Si lines 2516.1 and 2881.6 Å. are obtained from the measured densities of these lines by means of a density logarithm of intensity calibration pattern placed on each plate by means of a Hansen step diaphragm. From these results curves are constructed from which the composition of an unknown alloy can be determined.—A. R. P.

**The Use of the Spectrograph in the Platinum Industry.** H. E. Stauss (*Proc. Amer. Soc. Test. Mat.*, 1935, 35, (II), 57–60).—The chief value of the spectrograph in the laboratory of platinum refiners is to provide a rapid method of identification of alloys, to investigate the cause of local failures in Pt ware due chiefly to contamination with As, Si, or P, and to control the purity of Pt and its alloys for special purposes, e.g. gauze for ammonia oxidation catalysts. Since it is frequently difficult to dissolve the Pt metal alloys the spectrographic test is usually applied to small beads of the metal which are inserted into the graphite arc; usually 50 mg. are sufficient with a 20 minutes' exposure.—A. R. P.

**\*Simple Means for Detecting the Aluminium Alloys.** [After] E. Zurbrugg (*Rev. Aluminium*, 1935, 12, 3009–3013).—See *Met. Abs.*, this vol., p. 610.—J. H. W.

**Analysis of Stellite.** Z. S. Mukhina and K. A. Sukhenko (*Zavodskaya Laboratoriya (Works' Lab.)*, 1935, 4, (8), 870–874).—[In Russian.] The alloy is dissolved in HCl (1 : 4) or in  $\text{H}_2\text{SO}_4$  (1 : 5) and the solution evaporated with 30%  $\text{HClO}_4$  until thick fumes appear. Si, W, Mn, and Ni are determined as usual; Co is determined by titration with KCN with a correction for Ni, or by nitroso- $\beta$ -naphthol; Fe by cupferron, Al by  $\text{NH}_4\text{OH}$ , or 8-hydroxyquinoline, Cr in alloys with a Ni base by  $(\text{NH}_4)_2\text{S}_2\text{O}_8$ , and in alloys with a Co base iodometrically, Mo by 8-hydroxyquinoline, V with  $\text{KMnO}_4$  after determination of Si, W, Fe, Ni, Cr, Co, and C by combustion on a 0.25 gm. trial.—D. N. S.



**\*On Greater Accuracy in the Analysis of Nickel-Phosphor-Bronze.** E. I. Fogelson (*Zavodskaja Laboratoria (Works' Lab.)*, 1935, 4, (2), 228-229).—[In Russian.] To obtain a white precipitate of  $(\text{H}_2\text{SnO}_3)_n$  free from adsorbed Cu on dissolution of the alloy in  $\text{HNO}_3$ , the solution with precipitate is kept hot, but not boiling, until the latter becomes completely white.—D. N. S.

**\*Quantitative Analysis of Nickel Silver, Nickel, Constantan, and Similar Alloys, with Special Reference to Potentiometric Methods.** Werner Hiltner and Luzia Seidel (*J. prakt. Chem.*, 1935, 143, 94-99).—Cu and Pb are first determined electrolytically from  $\text{HNO}_3$  solution, and Fe is then precipitated as a basic acetate and the precipitate dissolved and titrated by the potentiometric method. One aliquot part of the filtrate from the Fe separation is used for the determination of Ni by titration with KCN. Zn is determined in another part of the filtrate by titrating with  $\text{Na}_2\text{S}$ , after adding KCN to prevent interference by Ni. Mn is determined in a separate portion of the alloy. The latter is dissolved in  $\text{HNO}_3$ , the Mn oxidized to  $\text{MnO}_4^-$  by the persulphate method, and the solution titrated hot with  $\text{Na}_2\text{C}_2\text{O}_4$  solution.—C. E. H.

**Work of the Analytical Committee of the Institute for the Study of Platinum and Other Noble Metals.** B. G. Karpov (Chairman), A. T. Grigoriev, S. F. Schemtchushny, O. E. Zviaginzev, N. S. Kurnakow, W. W. Lebedinsky, N. N. Podkopaev, and I. I. Tchernjaev (*Izvestia Platinogo Instituta (Ann. Inst. Platine)*, 1932, (9), 91-112).—[In Russian.] A concise summary of various analytical methods worked out and recommended by the Committee. (1) *A Method of Rapid Analysis of Nugget Platinum.* In addition to Pt, the sample contains Pd, Rh, Au, Cu, Ir, and separation is based on repeated digestion with aqua regia and fusion with various reagents. The method appears to be somewhat laborious. (2) *A Method of Analysis with Determination of only the Noble Metals.* This method is based on the same principle as (1); Pt, Au, Rh, Ir, and Ru are determined, the technique of estimation by difference being employed. (3) *A Method of Analysis including the Determination of Cu and Fe.* The Cu estimated is precipitated as  $\text{Cu}(\text{CNS})_2$  out of sulphate solution and determined as  $\text{CuO}$ , while the Fe is precipitated as the oxalate, re-dissolved in  $\text{HCl}$ , precipitated with  $\text{NH}_4\text{OH}$ , and determined as  $\text{Fe}_2\text{O}_3$ . (4) *Method of Complete Analysis.* The method is based on repeated digestion in strong reagents, determination of such metals as Cu and Fe by the ordinary methods, evaporating the various solutions to dryness and heating to reduce the residues containing noble metals. (5) *Method of Analysis of the "First Insoluble Residue" Resulting from Dissolving Nugget Platinum in Aqua Regia.* The residue contains Os, Ru, and Rh. (6) *A New Method of Separating Iridium and Platinum by B. G. Karpov and A. N. Fedorov.* The reagent is  $\text{Hg}_2\text{Cl}_2$ , which on heating precipitates Pt out of its chloride salts and chloroplatinates, while reducing Ir to the trivalent condition only. (7) *Analysis of Metallic Rhodium by B. G. Karpov.* The sample is fused with a very large excess of Ag, and dissolved in  $\text{HNO}_3$  and aqua regia. Pt, Pd, and Ir are removed and the Rh extracted by fusion with Bi and Pb. (8) *Assaying for Pt, Pd, Ir, and Rh of Ingots with a High Pt Content According to the Method Employed in the Laboratories of Johnson and Son.* A description of the method with the Institute's comments.—N. A.

**\*On the Magnetic Analysis of the Rare Earths.** M. N. Podashevski and V. V. Kondoguri (*Redkie Metalli (Rare Metals)*, 1935, (1), 40-44).—[In Russian.] Measurements of the magnetic susceptibility of  $\text{Pr}_2\text{O}_3$  and  $\text{Nd}_2\text{O}_3$  and of their binary mixtures, for their quantitative determination. The results give discrepancies of 1-1.5%. A description of the apparatus and review of the literature are given.—D. N. S.

**\*Losses in Cupellation.** Reduction by New Type of Cupel. J. T. King (*Chem. Eng. Min. Rev.*, 1935, 27, 378).—Brief abstract of a report of an investigation carried out at the University of Toronto.—J. H. W.

**Sampling of Silver Coin for Assay.** S. W. Smith (*Rep. Roy. Mint (Lond.)*, 1934, 65, 61–62).—The relatively wide variations in fineness which occur in different parts of the same silver coin of “500” standard calls for accurate sampling. Coins of moderate size which have been cut in double rows from the strip are sampled by taking equal portions of sectors from opposite sides, the larger coins being first rolled to about half their thickness. Large coins cut in single rows are sampled by taking equal portions of three small discs at regular intervals at a distance from the edge of the coin equal to  $\frac{1}{2}$  of the diameter.—J. H. W.

**Analysis of Tinplate.** — Wilmet and — Mathieu (*Ann. chim. anal. chim. appl.*, 1935, 17, 289; *C. Abs.*, 1936, 30, 48).—Instead of stripping off the plate, dissolving in acid, and analyzing the resulting solution for Sn and Pb, it is recommended to take a piece of the metal as anode, suspended it in 12% NaOH solution, and electrolyze at 75° C. with a Cu wire as cathode. After the electrolysis, the cathode is dissolved in HNO<sub>3</sub> and in a second electrolysis the Pb is deposited in the usual way on a Pt anode as PbO<sub>2</sub> and the electrolyte is filtered, leaving residual SnO<sub>2</sub>, which can be weighed.—S. G.

**\*On the Question of the Composition of Titanium Nitride.** E. A. Ostroumov (*Zavodskaja Laboratoria (Works' Lab.)*, 1935, 4, (5), 506–508).—[In Russian.] Analysis of specimens of titanium nitride gave values corresponding with, in one case, Ti<sub>5</sub>N<sub>6</sub>, and in another with Ti<sub>2</sub>N. [Note by Abstractor: The results may be vitiated by the presence of more than one compound or of solid solutions in the specimens examined.]—D. N. S.

**\*On the Investigation of the Chemical Composition of Hard Alloys.** S. L. Zinberg (*Zavodskaja Laboratoria (Works' Lab.)*, 1935, 4, (5), 578).—[In Russian.] In the analysis of Widia alloys free C is determined as graphite after dissolving the alloy in a mixture of HF and HNO<sub>3</sub>. A second portion is dissolved in HNO<sub>3</sub> and the C in the residue determined by combustion; a third portion is dissolved in HNO<sub>3</sub> and the W in the residue determined. If the CO<sub>2</sub> obtained by combustion is equivalent to the graphitic C, then all the W is considered as “free W.”—D. N. S.

**\*A New Colour Reaction for Beryllium by the Spot Method.** A. S. Komarovskiy and N. S. Poluektov (*Zhurnal Prikladnoi Khimii (J. Applied Chem.)*, 1934, 7, (5), 839–840).—[In Russian.] See *Met. Abs.*, 1934, 1, 510.—M. Z.

**\*A New Reaction for Bismuth.** M. V. Gapchenko and O. G. Sheintsis (*Zavodskaja Laboratoria (Works' Lab.)*, 1935, 4, (7), 835).—[In Russian.] Quinoline and KI give with acid Bi(NO<sub>3</sub>)<sub>3</sub> solutions a reddish-yellow precipitate of C<sub>9</sub>H<sub>7</sub>NHI·BiI<sub>3</sub> (sensitivity 0.02 mg./c.c.). Pb, Sb, Hg, and Ag do not interfere as their precipitates are less intensely coloured; Na<sub>2</sub>SO<sub>3</sub> must be added if Cu<sup>++</sup> or Fe<sup>+++</sup> are present.—D. N. S.

**\*A New Method of Fractional Detection of Cobalt.** L. M. Kulberg (*Zhurnal Prikladnoi Khimii (J. Applied Chem.)*, 1934, 7, (3), 406–408).—[In Russian.] Cf. *Met. Abs.*, this vol., p. 170. Hg<sup>++</sup> salts and NH<sub>4</sub>CNS give a complex salt which in acid solution liberates a mercuriothiocyanic acid which gives characteristically coloured insoluble double salts with divalent metals. The cobaltzinc double salt of this acid is adsorbed on the surface of the Zn salt and this property is used for a spot method of analysis for Co in the presence of all the usual cations and anions (including Fe and Ni). It is extremely simple and sensitive, requiring only 10 minutes.—M. Z.

**A Sensitive Reaction for Copper by the Spot Method.** A. S. Komarovskiy and N. S. Poluektov (*Zhurnal Prikladnoi Khimii (J. Applied Chem.)*, 1934, 7, (5), 844–846).—[In Russian.] Cu gives a purple colour with 8-hydroxyquinoline and KCN, the test being very sensitive in the absence of Fe<sup>+++</sup> salts.—M. Z.

**Fractional Detection of Zinc.** M. Schtchigol (*Zhurnal Prikladnoi Khimii (J. Applied Chem.)*, 1934, 7, (7), 1285–1287).—[In Russian.] Other metals are

removed by boiling with  $\text{Na}_2\text{CO}_3$  and  $\text{NaOH}$  before applying the  $\text{K}_4\text{Fe}(\text{CN})_6$  or  $(\text{NH}_4)_2\text{S}$  tests.—M. Z.

**The Separation of Certain Rare Earths.** P. W. Selwood (*J. Amer. Chem. Soc.*, 1935, 57, 1145).—In the separation of Eu from very large amounts of rare earths,  $\text{BaCl}_2$  is added to the concentrated chloride solution before reduction with amalgamated Zn; if  $\text{H}_2\text{SO}_4$  is added after reduction the  $\text{EuSO}_4$  is carried down by the  $\text{BaSO}_4$  and may be extracted therefrom by hot  $\text{HNO}_3$ . A partial separation of Sm from Nd is also described.—A. R. P.

**\*Improvements in the Vacuum Fusion Method for Determination of Gases in Metals.** Lewis Reeve (*Trans. Amer. Inst. Min. Met. Eng.*, 1934, 113, 82–102; discussion, 102–110).—See *Met. Abs. (J. Inst. Metals)*, 1933, 53, 564.—S. G.

**\*Microchemical Determination of Certain Cations by Means of Hexanitrodiphenylamine.** O. G. Sheintsis (*Zavodskaja Laboratoria (Works' Lab.)*, 1935, 4, (9), 1047–1052).—[In Russian.] A 2% aqueous solution of the Na salt of hexanitrodiphenylamine gives characteristic crystalline precipitates with  $\text{K}^+$  (in the absence of  $\text{NH}_4$  with which it forms an isomorphous precipitate),  $\text{Cs}^+$ ,  $\text{Rb}^+$ ,  $\text{Tl}^+$ ,  $\text{Bi}^{+++}$ ,  $\text{Zr}^{+++}$ ,  $\text{Pb}^{++}$ ,  $\text{Hg}^{++}$ . Other cations give either amorphous precipitates or none at all. Photographs of precipitates formed by the above cations are given.—D. N. S.

**Rapid Determination of Alumina by the 8-Hydroxyquinoline Method.** —Klasse (*Ber. deut. Keram. Ges.*, 1934, 15, 560–571).—A volumetric method based on precipitation of the Al with 8-hydroxyquinoline is described, by the use of which the  $\text{Al}_2\text{O}_3$  content of refractories can be determined in 2 hrs. with an accuracy of  $\pm 0.5\%$ .—A. R. P.

**\*Determination of Aluminium by Titration of Excess of 8-Hydroxyquinoline (Oxine).** S. S. Zhukovskaia and S. T. Baluk (*Zavodskaja Laboratoria (Works' Lab.)*, 1935, 4, (4), 397–401).—[In Russian.] The Al is precipitated with a known volume of standard oxine solution in the presence of  $\text{CH}_3\text{CO}_2\text{Na}$ , the precipitate is removed and the filtrate acidified with  $\text{HCl}$ , and the oxine excess titrated with  $\text{KBr}-\text{KBrO}_3$  solution.—D. N. S.

**\*Volumetric Method for Determining Aluminium.** N. M. Chervikov and E. N. Deichman (*Zavodskaja Laboratoria (Works' Lab.)*, 1935, 4, (5), 508–510).—[In Russian.] In one portion of the solution the free acid is titrated with 0.1N-NaOH in the presence of  $\text{Na}_2\text{C}_2\text{O}_4$  (phenolphthalein indicator); to a second portion a slight excess of Rochelle salt is added, and the acidity again determined. The difference between the two titrations is equivalent to the acid liberated by the reaction:  $\text{NaKH}_2\text{C}_4\text{O}_6 + \text{AlCl}_3 + \text{H}_2\text{O} = \text{Al}(\text{OH})\text{KH}_2\text{C}_4\text{O}_6 + \text{NaCl} + 2\text{HCl}$ .—D. N. S.

**\*On the Colorimetric Determination of Aluminium with Sodium Alizarin-sulphonate.** S. N. Rozanov and G. A. Markova (*Zavodskaja Laboratoria (Works' Lab.)*, 1935, 4, (9), 1023–1031).—[In Russian.] Attack's method has been critically examined. The intensity of the colour produced by alizarin in Al solutions depends not only on the Al content but also on the  $p_{\text{H}}$  of the solution when the alizarin is added, on the rate at which  $\text{CH}_3\text{CO}_2\text{H}$  is added, and on the quantity of alizarin present. Since the intensity of the colour is proportional to the Al content only within a very narrow concentration range, the concentration of the standard solution must not differ from that of the test solution by more than 10%. Fe must be absent; addition of citric acid does not prevent its interference. It is concluded that Attack's method is not reliable.—D. N. S.

**\*The Determination of Antimony in Alloys by Means of Permanganate.** A. Jilek and J. Vřestál (*Chem. Listy*, 1934, 28, 132–135; *C. Abs.*, 1935, 29, 7856).—Dissolve 1 grm. of the alloy in 10 c.c. of hot, concentrated  $\text{H}_2\text{SO}_4$  and dilute the solution with 50 c.c. of  $\text{H}_2\text{O}$ . Add 6 grm. of  $\text{NH}_4\text{Cl}$  and boil for 3–5 minutes to remove  $\text{SO}_2$ . Cool, add 10 grm. of  $\text{NH}_4\text{Cl}$ , and, if the Sb content exceeds 0.2 grm., or if a large volume of  $\text{H}_2\text{SO}_4$  was evaporated during the decom-



position, 5 c.c. of concentrated HCl. Make up to 200 c.c. with  $H_2O$ , cool to  $4^{\circ}$ – $8^{\circ}$  C., and titrate with 0.1N  $KMnO_4$ . When 0.4–0.8 gm. of Cu was present, an addition of 10%  $CoSO_4$  solution decolorized the solution sufficiently to make the end-point more precise.—S. G.

**\*On the Determination of Beryllium by Quinalizarin.** V. A. Nazarenko (*Zavodskaja Laboratoria (Works' Lab.)*, 1935, 4, (3), 296–297).—[In Russian.]  $Fe(OH)_3$ ,  $Al(OH)_3$ , and  $Be(OH)_2$  are precipitated with  $NH_4OH$ , the precipitate is extracted with hot KOH and the alkaline solution is treated with quinalizarin for the colorimetric determination of Be;  $Ca^{++}$  and  $Ba^{++}$  interfere slightly but should be separated by the preliminary  $NH_4OH$  precipitation.—D. N. S.

**Estimation of Iron in the Presence of Titanium—An Aeration Process.** William M. Thornton, Jr., and Reuben Roseman (*J. Amer. Chem. Soc.*, 1935, 57, 619–621).—The mixed sulphate solution is reduced with Zn or Zn amalgam and the  $Ti^{+++}$  reoxidized by drawing air through the solution for 10–20 minutes.  $FeSO_4$  remains unoxidized and may be titrated directly with  $KMnO_4$ .—A. R. P.

**\*Quantitative Determination of Lead in Alloys.** M. V. Gapchenko and O. G. Sheintsis (*Zavodskaja Laboratoria (Works' Lab.)*, 1935, 4, (8), 868–870).—[In Russian.] The alloy is dissolved in  $HNO_3$ , the Sn and Sb removed, and the solution treated with  $NH_4OH$  just sufficient to dissolve the Cu and  $CH_3CO_2NH_4$  to dissolve  $Pb(OH)_2$ ; the Pb is then precipitated with  $NaHSO_3$  as  $PbSO_3$  which is collected in a Gooch crucible, dried at  $105^{\circ}$  C. and weighed, or alternatively dissolved in 10 c.c. of 2N-NaOH and the  $SO_3^{--}$  determined iodometrically.—D. N. S.

**A New Volumetric Method for the Estimation of Lead.** Sachindra Nath Roy (*J. Indian Chem. Soc.*, 1935, 12, (9), 584–585).—A simple method for estimation of Pb, in the absence of other metallic ions, by titration with  $K_2SO_4$  with fluoroscein as indicator.—R. G.

**\*Microvolumetric Method of Determining Lead.** M. V. Gapchenko (*Zavodskaja Laboratoria (Works' Lab.)*, 1935, 4, (9), 1014–1016). [In Russian.] The Pb is precipitated with  $NaHSO_3$  (or  $Na_2SO_3$  in the absence of other metals precipitable by  $Na_2SO_3$ ), the  $PbSO_3$  dissolved in NaOH and oxidized to  $PbSO_4$  by addition of I solution, the solution acidified and the excess of I titrated with  $Na_2S_2O_3$ . Amounts of Pb as small as 0.05 mg. can be determined in the presence of Fe and Cu.—D. N. S.

**\*Methods for Determining Lead Oxide in Metallic Lead.** J. Gamzulov and V. Bedova (*Zavodskaja Laboratoria (Works' Lab.)*, 1935, 4, (8), 867–868).—[In Russian.] The oxide is extracted by treating shavings of the metal for 1 hr. with hot 5%  $CH_3CO_2H$  and the dissolved Pb is determined as sulphate. The results obtained are in good agreement with those obtained by  $H_2$  reduction.—D. N. S.

**Estimation of Magnesium as the Oxide in the Presence of Ammonium Salts.** N. A. Tananaeff and I. D. Frolov (*Zhurnal Prikladnoi Khimii (J. Applied Chem.)*, 1934, 7, (4), 609–612).—[In Russian.] Mg can be precipitated by NaOH from solutions containing  $NH_4$  salts if sufficient  $H\cdot CHO$  is added to convert the  $NH_4^+$  into  $(CH_2)_6N_4$ .—M. Z.

**Volumetric Determinations in Strongly Alkaline Solutions. II.—The Titration of Manganese with Ferricyanide.** O. Tomíček and J. Kalný (*J. Amer. Chem. Soc.*, 1935, 57, 1209–1211).—The solution (0.02M with respect to Mn) is treated with 1 gm. of tartaric acid, covered with a 2 cm. layer of  $C_6H_6$  to exclude air, treated with NaOH (air-free) until 1.5–2N, and titrated potentiometrically with 0.1 or 0.05M- $K_3Fe(CN)_6$  to the point of maximum inflection. The air in the vessel should be replaced with  $CO_2$  before addition of NaOH. Cu, Zn, Ni, Co, As, Fe, Al, P, and Mo have no effect.—A. R. P.

**A Rapid Method for Determining Mercury.** F. I. Trishin (*Zhurnal Prikladnoi Khimii (J. Applied Chem.)*, 1934, 7, (7), 1282–1284).—[In Russian.] The Hg is separated from other metals by treating the solution successively with Br,

KI, NaOH, and  $\text{Na}_2\text{S}$ , being recovered as  $\text{HgS}$  by acidification of the filtrate with HCl. Sn, Sb, and Ag interfere.—M. Z.

"Spot" Method for Approximate Quantitative Estimation of Platinum. N. A. Tananaeff and G. T. Michaltschischin (*Zhurnal Prikladnoi Khimii* (*J. Applied Chem.*), 1934, 7, (4), 613-615).—[In Russian.] See *Met. Abs.*, 1934, 1, 89.—M. Z.

\*A New Method for Separating Molybdenum from Rhenium for the Colorimetric Determination of the Latter. V. I. Bibikova (*Redkie Metalli* (*Rare Metals*), 1935, (6), 24-26).—[In Russian.] Mo interferes in the colorimetric determination of Re with KCNS. Prior separation of the Mo by 8-hydroxyquinoline in  $\text{CH}_3\text{CO}_2\text{H}$  solution is incomplete, but the remaining Mo can be separated by adding dilute  $\text{H}_2\text{SO}_4$  and K xanthate and extracting the Mo complex with  $\text{CHCl}_3$ . The aqueous layer is then treated with dilute HCl and 5-6 mg. of Pb, and saturated hot with  $\text{H}_2\text{S}$ . The precipitate is dissolved in alkali, the solution oxidized with  $\text{H}_2\text{O}_2$ , and the colorimetric determination made as usual.—D. N. S.

Applicability of Potentiometric Silver Titration in Determining Silver in Practice. E. Raub (*Mitt. Forschungsinst. Edelmetalle*, 1934, 8, 1-11).—See *Met. Abs.*, 1934, 1, 611.—S. G.

\*On the Question of the Rapid Determination of Uranium, Vanadium, and Iron when Present Together. E. A. Ostroumov (*Zavodskaya Laboratoriya* (*Works' Lab.*), 1935, 4, (7), 754-757).—[In Russian.] In one portion of the solution V is determined with  $(\text{NH}_4)_2\text{S}_2\text{O}_8$ , in a second portion  $\text{Fe} + \text{V}$  are determined by Zimmermann's method and in a third the total  $\text{U} + \text{Fe} + \text{V}$  are titrated after reduction with bismuth amalgam by Someya's method.—D. N. S.

\*Determination of Zinc in Copper Alloys Containing less than 0.5 Per Cent. Zinc. Christo Nikolow (*Przemysl Chem.*, 1935, 19, 137-139; *C. Abs.*, 1936, 30, 408).—0.6 grm. of Al filings is quite sufficient to displace 1 grm. Cu from solution. The solution should contain 8 ml. HCl (1 : 1) per 100 ml. The precipitation should last less than 1 hr. (Sn if present should be removed first by dissolving the sample in  $\text{HNO}_3$ ). Tests in which quantitative additions of Zn were determined showed this method to be accurate.—S. G.

Normal Propylarsonic Acid as a Reagent for the Determination of Zirconium. F. W. Arnold, Jr., and G. C. Chandler (*J. Amer. Chem. Soc.*, 1935, 57, 8).—In boiling 10 volume-% HCl solutions addition of a 5% solution of the normal propylarsonic acid precipitates Zr completely as a flocculent, readily filtrable precipitate which can be ignited directly to  $\text{ZrO}_2$  for weighing. The method is claimed to afford a means of separating Zr from Sn, Ti, Th, Al, V, Cr, Co, Mn, Ni, Cu, Fe, Cu, Zn, Be, U, and Mo. In a later note (*ibid.*, 591) G. C. C. states that the directions given are inadequate for the separation of Zr from Sn.—A. R. P.

## X.—LABORATORY APPARATUS, INSTRUMENTS, &c.

(See also "Testing" and "Temperature Measurement and Control.")

(Continued from pp. 616-618.)

The Electron Microscope and Its Application, Especially to the Study of Thin Films on Metals. E. Brüche (*Kolloid-Z.*, 1934, 69, 389-394).—See also *Met. Abs.*, 1934, 1, 196. Describes the apparatus and technique, and illustrates the application of the method to the study of metallic surfaces.—S. G.

New Technique for Obtaining X-Ray Powder Patterns. R. A. Stephen and R. J. Barnes (*Nature*, 1935, 136, 793-794).—A flat specimen mounted in a circular camera is employed to diffract X-rays, and is arranged at a small angle to the incident wide beam of parallel X-rays. The apparatus can be used to

photograph all or only a few lines. The apparatus can also be adapted to provide a narrow intense beam of polarized monochromatic X-rays.

—J. S. G. T.

\***Chamber for Determining the Identity Period in X-Ray Analysis of Structures.** E. F. Bachmetew (*Zhurnal Tehnicheskoy Fiziki (J. Tech. Physics)*, 1935, 5, (1), 118–123).—[In Russian.]—N. A.

\***Apparatus for Comparing X-Ray Diagrams.** E. Paray-Koshiz (*Zhurnal Tehnicheskoy Fiziki (J. Tech. Physics)*, 1935, 5, (1), 176–177).—[In Russian.]—N. A.

\***New Experimental Model of an X-Ray Camera.** G. Komovski (*Zhurnal Tehnicheskoy Fiziki (J. Tech. Physics)*, 1935, 5, (2), 347–348).—[In Russian.] A Debye camera with automatic centering of the specimen and rapid fixing of film is described.—N. A.

\***X-Raying of Metals and Structural Details by Secondary X-Rays.** M. A. Gurevitch (*Zhurnal Tehnicheskoy Fiziki (J. Tech. Physics)*, 1935, 5, (5), 884–887).—[In Russian.] The method detects internal defects in parts inaccessible to direct illumination with a primary pencil.—N. A.

\***Comments on the Article by M. A. Gurevitch on “X-Raying of Metals and Structural Details by Secondary X-Rays.”** A. P. Komar (*Zhurnal Tehnicheskoy Fiziki (J. Tech. Physics)*, 1935, 5, (5), 888).—[In Russian.] Cf. preceding abstract. Defects of the method are pointed out.—N. A.

## **XI.—PHYSICAL AND MECHANICAL TESTING, INSPECTION, AND RADIOLOGY**

(Continued from pp. 618–619.)

**Representative Samples and Commercial Testing.** A. Haas (*Engineer*, 1935, 159, (4128), 202–203).—The sampling of non-ferrous bar is dealt with.

—R. Gr.

**Aircraft: Materials and Testing.** L. B. Tuckerman (*Proc. Amer. Soc. Test. Mat.*, 1935, 35, (II), 3–46).—The Edgar Marburg Lecture. The development of light-weight constructions in aircraft production is critically reviewed, and it is shown that the securing of such constructions is dependent on spreading out the material as far as possible from the axis of the structure or its elements; the limit of this spreading is set by local instabilities which cause wrinkling, twisting, crumpling, or other types of collapse, and the problem is, therefore, to obtain the best balance between plastic yielding, depending on the strength-density ratio of the material, and major or local instabilities, depending on the modulus-density ratio, and the transitions between them, depending on an accurate knowledge of the stress-strain curves. These points are illustrated by examples of simple structural members used in aircraft, and the significant properties of selected materials are compared; this comparison shows that there is little to choose between wood, light alloys, and high-strength alloy steels for aircraft construction. Since the modulus-density ratio is still the limiting property of the material and is practically unaltered by any treatment that can be given to the material it follows that no radical improvement in light-weight construction can be expected from further improvement in the strength of materials. Possible improvements in design are indicated.

—A. R. P.

**A Survey of Testing in the Precious Alloy Field, with Some Notes on the Testing Requirements for Duplex Alloys.** Thomas A. Wright (*Proc. Amer. Soc. Test. Mat.*, 1935, 35, (II), 341–362; discussion, 363–369).—In the precious metal field the usual tests required are chiefly of an analytical nature except in the case of electroplate of any kind where tests for hardness, corrosion, wear-corrosion, thickness, and distribution are required. Some standard speci-



fications are needed in all branches of the industry and a few suggestions are made for standard tests. The standardization of gold-clad materials, e.g. gold plate and rolled-gold, is discussed at length, and the value of a number of tests, metallographic, analytical, stripping, and physical, is illustrated with reference to numerous examples.—A. R. P.

**A New Method of Investigating Performance of Bearing Metals.** J. R. Connelly (*Trans. Amer. Soc. Mech. Eng.*, 1935, 57, IS 35-39; *C. Abs.*, 1935, 29, 7913).—The test consists of holding by constant force a specimen of bearing metal, one side of which is machined to a plane surface, against a steel cylinder rotating in a bath of lubricant. The characteristics of the test are: (1) conditions existing in an actual bearing are reproduced as to lubrication, metals used, physical proportions, and wear; (2) the validity of the test is independent of any assumption that data on abrasion are directly convertible to data on wear; (3) varying area of contact gives the rate of wear for a wide range of unit pressure; and (4) the data obtainable are directly usable for purposes of design.—S. G.

**An Apparatus for Determination of Wear.** T. V. Kudrjavtzev and N. T. Feigin (*Niimash (Bull. Sci. Res. Inst. Machine-Building and Metal-Treatment)*, 1935, (8), 49-51).—[In Russian.] A machine designed by the authors is described.—N. A.

**Note on the Roughness [of Metal Surfaces] and Modern Methods Used in Smoothing Such Surfaces.** E. Bodart (*Rev. univ. Mines*, 1934, [viii], 10, 544-553).—Mathematical analysis shows that it is almost impossible to define a quantity which can serve as a measure of roughness although it is possible to calculate the mean deviation of the surface contour from the ideal. Various optical methods for obtaining the necessary data for this calculation are reviewed.—A. R. P.

**An Apparatus for the Measurement of Roughness.** D. Clayton (*Engineering*, 1935, 139, 325-326).—The apparatus is described, and typical results are given and discussed.—R. Gr.

**\*High-Speed Fatigue Tests of Several Ferrous and Non-Ferrous Metals [Duralumin; Brass] at Low Temperatures.** W. D. Boone and H. B. Wishart (*Proc. Amer. Soc. Test. Mat.*, 1935, 35, (II), 147-152; discussion, 153-155; and (summary) *Met. Ind. (Lond.)*, 1935, 47, 122-123).—See *Met. Abs.*, this vol., p. 355.—S. G.

**Testing Cable-Sheaths for Fatigue.** C. H. Greenall (*Wire and Wire Products*, 1935, 10, 267-269, 293).—Methods of determining the fatigue limits and endurance of cable-sheathing under vibratory stresses are briefly described with special reference to the development of the machines.—A. R. P.

**\*The Rotating-Wire Arc Fatigue Machine for Testing Small-Diameter Wire.** J. N. Kenyon (*Proc. Amer. Soc. Test. Mat.*, 1935, 35, (II), 156-164; discussion, 165-166).—See *Met. Abs.*, this vol., p. 355.—S. G.

**Fatigue-Testing Machine for Wire.** — (*Wire and Wire Products*, 1935, 10, 272-274, 284-285).—A description is given of the principles, construction, and use of the Haigh-Robertson machine.—A. R. P.

**An Electromagnetic Fatigue Tester.** — (*Engineering*, 1935, 140, 406; and *Engineer*, 1935, 160, 201).—See *Met. Abs.*, this vol., p. 480.—R. Gr.

**The Endurance Strength of Metallic Materials, and Its Relation to Design.** D. W. Rudorff (*Z.V.d.I.*, 1935, 79, (15), 453-458; and (abridged translation) *Metal Treatment*, 1935, 1, 202-204, 209).—A review, with bibliography, is given of investigations of creep in metals undertaken since 1930. The aims, fundamental assumptions, method, and special difficulties of creep testing are discussed, and brief summaries are given of the respective points of view of Tapsell, McVetty, Bailey, Holdt, and others. Lack of care in the interpretation of experimental data may give rise to serious misconceptions. Bailey's method of calculating permissible stresses from the results of creep

tests is described: the method has been extended to pieces of a variety of forms.—P. M. C. R.

\***The Use of the Hele-Shaw Apparatus in the Investigation of the Flow of Metals.** A. M. Herbert and F. C. Thompson (*J. Iron Steel Inst.*, 1935, 132, 117-124; discussion, 125-134; and (summary) *Iron Coal Trades Rev.*, 1935, 131, 430-434).—See *Met. Abs.*, this vol., p. 532.—S. G.

**Technique of Mechanical Tests on Metals at Low Temperatures.** A. S. Falkevich (*Zavodskaja Laboratoria (Works' Lab.)*, 1935, 4, (9), 1097-1100).—[In Russian.] A review.—D. N. S.

**Amsler Universal Cupping-Test Machine.** — (*Engineering*, 1935, 139, 660).—Briefly describes the machine and its uses.—R. Gr.

**Dynamic Rupturing Tests on Aluminium and Copper.** E. Honegger (*Schweiz. Archiv angew. Wiss. Tech.*, 1935, 1, 55-62).—A method for determining the breaking strength of metals and alloys under the application of dynamic forces is described and indicates the serviceability of copper and aluminium. Both metals show greater values than when the tests are made under static conditions.—W. A. C. N.

**The Relation Between the Tension, Static, and Dynamic Tests.** H. C. Mann (*Proc. Amer. Soc. Test. Mat.*, 1935, 35, (II), 323-335; discussion, 336-340).—Experiments on steels using a tension form of specimen which could be tested under both static and dynamic conditions have shown that the mechanism of deformation is the same in both tests, the work involved in producing the deformation depending on force, time, and space and being, therefore, independent of the magnitude of the applied force. The rate of deformation for maximum energy conversion depends on the composition and condition of the material, whilst the dynamic properties of a material depend chiefly on the volume, velocity of the applied force, and material condition. Modern types of impact machines are considered to be too limited in respect of velocity to determine the complete dynamic properties of metals and alloys since a large range of velocities is necessary to reveal definitely embrittlement.—A. R. P.

\***Tension Tests of Antifriction Alloys at Elevated Temperatures.** Jean Galibourg, Léon Guillet, Jr., and — Popoff (*Rev. Mét.*, 1935, 32, 393-397).—A special form of tensile test-piece was used having collars at the ends of the test length for attachment of an extensometer permitting measurements of 0.001 mm. on a 20 mm. test length. Tests were carried out (a) at constant temperature with increasing load, and (b) with increasing temperature at constant load. The material of the test-pieces is not described.—H. S.

**The Hardness Testing of Light Metals and Alloys.** R. L. Templin (*Proc. Amer. Soc. Test. Mat.*, 1935, 35, (II), 283-297; discussion, 298-304; and (summary) *Met. Ind. (Lond.)*, 1935, 47, 157-158).—See *Met. Abs.*, this vol., p. 356.—S. G.

**A New Method and Machine for Dynamic Hardness Testing.** W. M. Patterson (*Proc. Amer. Soc. Test. Mat.*, 1935, 35, (II), 305-315; discussion, 316-322).—See *Met. Abs.*, this vol., p. 356.—S. G.

**The Diamond in Hardness Testing.** Paul Grodzinski (*Tech. Zentr. prakt. Metallbearbeitung*, 1934, 44, 46-49).—A description is given of the construction and use of Rockwell and Vickers Pyramid hardness testers with diamond indenters and of the Reindl and Nieberding scleroscope with diamond point. Curves and nomograms for converting the hardness numbers obtained by these methods into Brinell numbers are also included.—A. R. P.

**The Griffin-Gale Testing Machine.** — (*Engineer*, 1935, 159, (4132), 308-309).—A description of the machine, which is a small or table type.—R. Gr.

†**Methods for Measuring the Thermal Conductivity of Metals.** N. D. Tomashev and J. B. Fridman (*Zavodskaja Laboratoria (Works' Lab.)*, 1935, 4, (5), 539-547).—[In Russian.] A survey of the methods and description of installations at the All-Union Institute of Aviation Materials.—D. N. S.

**The X-Ray Examination of Welds.** R. A. Stephen (*Symposium on Welding of Iron and Steel, Iron Steel Inst., 1935, 2, 915-923*).—See *Met. Abs.*, this vol., p. 480.—H. W. G. H.

## XII.—TEMPERATURE MEASUREMENT AND CONTROL

(Continued from pp. 619-621.)

**Automatic Temperature Control for Furnaces.** E. F. Baker (*Modern Eng., 1935, 9, 327-329*).—Various methods of control for fuel or electric furnaces are discussed in a general way, leading to a description of an instrument in which the differential expansion of a heat-resisting steel tube and a silica rod inside it controls the vent of a pneumatic relay valve, which, in turn, operates the controls of the furnace. The lag, usual with sheathed thermocouples, is said to be eliminated.—H. W. G. H.

## XIII.—FOUNDRY PRACTICE AND APPLIANCES

(Continued from pp. 621-625.)

**Metal Melting—Its Effect on Quality.** H. W. Brownson (*J. Inst. Metals, 1935, 57, 17-30*; general discussion, 31-52).—Autumn Lecture, 1935. The bearing of the following factors on the quality of metal and alloy castings is discussed at some length: the purity of the metals used with especial reference to the effect of additions of scrap, contamination by oxygen from the air and by substances picked up from the furnace atmosphere, the crucible, or the stirring rod, the removal of undesirable impurities during melting by treatment with fluxes, deoxidants, desulphurizers, charcoal covers, and streams of active or inert gases, the refinement of grain structure in castings by additions of grain refiners, and the use of vacuum and various gaseous atmospheres to prevent contamination of the molten metal. In the discussion R. S. Hutton suggested filtration through refractories and intensive treatment with fluxes as possible lines for research in the improvement of castings. C. J. Smithells emphasized the extraordinary effect of minute quantities of certain impurities on the properties of metals and stated that melting in hydrogen was the best means of getting thoroughly deoxidized castings especially of nickel or its alloys. A. J. Murphy described modern practice in melting chromium and magnesium and their alloys. D. Hanson reviewed recent work on the effects of gases in metals and phenomena associated with the gas/metal equilibrium with especial reference to the cases of copper and silver with oxygen, and iron with hydrogen and nitrogen, and discussed the importance of water-vapour in furnace atmospheres. W. J. P. Rohn stated that nickel and iron can be purified by melting with a small quantity of carbon and then reducing the pressure to a low value to cause the absorbed carbon monoxide to be expelled and to remove the last of the carbon by reaction with the magnesia lining of the crucible, and that the impact resistance and fatigue limit of a 15:20:65 chromium-nickel alloy are considerably increased by melting *in vacuo*. G. L. Bailey discussed the problem of removing the products of deoxidation from a molten metal from the colloid theory point of view; liquid products should be much more readily removed than solid products owing to the greater ease with which the particles coalesce. More efficient cleansing of molten metals by fluxes should be obtained by pouring the metal from a great height in a thick stream into the molten flux so as to effect a thorough mixing. A. Logan stated that a small addition of phosphor-copper to Admiralty gun-metal increased the density, improved the physical properties, and allowed of repeated remelting without deterioration. F. W. Rowe stated that difficulties due to gas absorption by molten brass and bronze are eliminated by using a rocking-arc type of furnace for melting, which was confirmed by



A. G. Robiette, who stated that the capacity of this type of plant already installed in this country exceeds 100,000 tons per annum. Other speakers discussed various points on gas absorption, flux cleaning, and scrap melting.

—A. R. P.

**Spongy Spot and the Leonard Effect.** M. Kagan (*Found. Trade J.*, 1935, 53, (997), 224-225).—Paper read before the International Foundry Congress in Brussels. The development of spongy spots is distinguished from various types of accidental porosity. Spongy spot defects are attributed either to the Leonard affect (the excessive local heating of re-entrant portions of the sand mould) or to the penetration of core gases into the liquid metal under certain conditions of pressure. Instances of the defect in ferrous and non-ferrous materials are described. The form of the mould is considered the primary factor, although an important part is played by the type of sand employed.

—P. M. C. R.

**Metal Casting of To-Day.** W. Claus (*Tech. Zentr. prakt. Metallbearbeitung*, 1935, 45, 286-289).—A historical survey of the progress of casting methods since 1860. An attempt is also made to foretell the probable advances in the near future. These prophecies include: (1) the use of copper and nickel in their respective alloys in minimum quantities; (2) the complete elimination of tin; (3) a greater use of lead; (4) the more extended use of zinc, aluminium, and magnesium and their alloys; (5) the development of alloys whose special mechanical and chemical properties depend on the additions of small amounts of certain constituents to established classes of materials.—W. A. C. N.

**\*Observations on the Porosity and Segregation of Two Bronze Ingots.** (Allen and Puddephat.) See p. 675.

**\*Metal Losses in Melting Brass and Other Copper Alloys.** Maurice Cook (*J. Inst. Metals*, 1935, 57, 53-68; discussion, 68-77).—A study was made of the metal losses which occur when such alloys as gilding metals, brasses, and cupro-nickel are melted in crucibles in coke-fired pit furnaces, and for this purpose figures were obtained both from carefully controlled trials and from production runs, involving the melting of considerable quantities of material under different conditions. Observations were also made on the metal losses occurring in melting brasses of different compositions under various conditions of fluxing in Ajax-Wyatt induction furnaces, and large-scale trials covering considerable periods and involving large tonnages of metal were made. The loss is largely due to oxidation and the results of various methods of reducing the loss, such as varying the nature and amount of flux, the use of charcoal, coke, anthracite, and coal-gas, which have been tried are discussed.—M. C.

**Special Brasses in the Foundry.** Erich Becker (*Giesserei*, 1935, 22, (5), 108-114; and (abridged translation) *Metal Treatment*, 1935, 1, 88-91).—The constitution of the copper-zinc alloys is correlated with their physical and mechanical properties, and the influence on the latter of additions of aluminium, iron, manganese, and nickel is described. Recommended practice involves the preliminary melting together of the required foundry alloys, their addition to the main melt, the casting of the latter in slabs, and the remelting of the slabs for final casting: special precautions against the formation of blow-holes and other defects are described. For a variety of purposes the special brasses are superior to the bronzes and high brasses.—P. M. C. R.

**The Pressure Die-Casting of Alloys.** Ladislav Jenicek (*Met. Ind. (Lond.)*, 1935, 47, (17), 411-416; and (summary) *Rev. Fonderie moderne*, 1935, 29, 163-164).—Paper presented before the International Foundry Congress, Brussels, April, 1935. The essentials of the hot-chamber and cold-chamber processes are reviewed, and proprietary types of hot-chamber machine are described: they are mainly distinguished by the horizontal or vertical position of the cold chamber and by the plane of the parting line of the die. The increasing application of cold-chamber casting to alloys of low melting point

necessitates careful temperature control if segregation, e.g. in zinc-base alloys, is to be avoided. The plasticity range of the respective alloys must also be considered in its relation to pressures and speeds. The conditions influencing surface finish are reviewed, and results obtained in practice with various copper-base, zinc-base, aluminium-base, and ultra-light alloys are described. —P. M. C. R.

**Die-Casting.** P. Bastien (*Technique moderne*, 1934, 26, (12), 407-412).—This review of die-casting practice includes illustrated descriptions of hot-chamber and cold-chamber machines, an account of common defects in die-cast material, a discussion of the principal types of die-casting alloy, and a bibliography.—P. M. C. R.

**Die-Casting of Brass.** John R. Freeman, Jr. (*Trans. Amer. Inst. Min. Met. Eng.*, 1935, 117, 371-377; discussion, 377-380).—See *Met. Abs.*, this vol., p. 358.—S. G.

**Die-Casting with Machines of Simple Design (—II).** ——— (*Machinery (Lond.)*, 1935, 47, 241-245).—See *Met. Abs.*, this vol., p. 536.—J. C. C.

**Limitations in the Use of Die and Pressure Castings of Metals and Plastic Materials.** B. Bodenmüller (*Tech. Zentr. prakt. Metallbearbeitung*, 1935, 45, 290-292).—A summary of the principal factors which operate in the manufacture and use of these castings—the size, form, weight, appropriateness of material, the need for further work on the casting, necessary tolerances, and the probable cost.—W. A. C. N.

**A Centrifugal Casting Machine.** S. E. Noskov (*Vestnik Metallopromishlennosti (Messenger Metal Ind.)*, 1935, 15, (7), 132-141).—[In Russian.] A detailed description of the design of Y. F. Zakharin's centrifugal machine for non-ferrous and ferrous metals.—D. N. S.

**\*Study of the Drying of Foundry Cores.** A. H. Dierker (*Bull. Ohio State Univ. Exper. Station*, 1935, 7, (3), 10-12).—Comparative studies of the preliminary drying and subsequent baking of foundry cores of different sizes are described; curves are reproduced which show the influence of oven temperature on drying time, the influence of spacing, the effect of perforations in the core plate, and the rate of drying at decreasing oven temperatures. The results in the last instance indicate a possible economy in time and fuel with an oven of suitable design.—P. M. C. R.

#### XIV.—SECONDARY METALS: SCRAP, RESIDUES, &c.

(Continued from p. 626.)

**Secondary Aluminium.** Robert J. Anderson (*Monthly J. Inst. Metals*, 1934, 1, 186-192).—A brief review is given of the magnitude of the secondary aluminium industry, the sources of scrap, and the applications of remelted scrap, and recent developments in practice.—A. R. P.

#### XV.—FURNACES AND FUELS

(Continued from pp. 626-628.)

**Charging Machine for Copper-Refining Furnaces.** ——— (*Engineering*, 1935, 140, 63-64).—Describes the mechanical features of a charging machine. —R. Gr.

**Controlled Protective Atmospheres for Furnace Use.** A. R. Ryan (*Indust. Heating*, 1935, 2, 633-640).—Special atmospheres are used in heating furnaces to protect the surface of the materials from undesirable changes such as oxidation, decarburization, or carburization. The equilibrium curves for various gas mixtures at increasing temperatures up to 1100° C. are shown. Impurities in the metal, e.g. oxygen in copper, often dictate the procedure to be adopted in the

bright-annealing of the metal, and a gas which is suitable for one alloy may not be suitable for another. In the purification of town's gas an automatically controlled, electrically heated chamber containing cast iron and copper chips which remove oxygen and sulphur, and also a dehydrating equipment are used. Dissociated ammonia is produced in an electric furnace carrying a tube containing a catalyst over which dried ammonia passes. The products of dissociation are frequently used in a semi-burnt condition. In the most widely used atmosphere controller the raw hydrogen gas passes through a flow-meter into a combination air and gas compressor. Atmospheric air enters the compressor through another flow-meter. The air and gas are mixed in the desired ratio in the compressor and the mixture then passes to the burner and in the combustion chamber impinges on a hot refractory catalyst, where burning occurs. All oxygen is thus used up, but the precaution is taken to pass the combustion gases over more catalyst at a later stage in the combustion chamber. The gases eventually pass to a cooler to condense water vapour.—W. A. C. N.

**Forced-Draught Coke-Fired Crucible Furnace.** — (*Engineer*, 1935, 160, (4148), 46).—A brief description of a furnace consisting of rectangular steel box lined with firebricks, containing a special form of grill to distribute the air blast over the surface of the crucible.—R. Gr.

**Special Furnace Atmospheres for Heat-Treating and Brazing.** C. L. West (*Indust. Heating*, 1935, 2, 499–502, 509–510).—See *Met. Abs.*, this vol., p. 359. —W. A. C. N.

**Heat-Treatment by Forced Convection.** W. A. Darrah (*Metal Progress*, 1935, 27, (5), 55–60, 80; and (summary) *Light Metals Research*, 1936, 4, 247–249).—It is claimed that a "recirculating" system of furnace heating, i.e. the inclusion in the circuit of a fan which withdraws the hot products from the combustion chamber and forces them through the heating chamber back to the combustion space, affords the maximum rate of heating consistent with uniformity. The initial cost is not great, and a considerable economy in fuel is combined with uniformity of heating. Tempering and brass-melting furnaces operated on this principle are described and illustrated.—P. R.

**The Development of Convection. Heating Equipment.** — (*Indust. Heating*, 1935, 2, 476–492).—A general review of the developments in this field, freely illustrated to show modern types of furnaces. Convection heating is effected by heated air, or, in some instances, by special gas mixtures. Air is drawn or forced into contact with electrically heated elements or with hot combustion gases. The heated air enters the furnace under slight pressure and passes around the work causing quick heat transfer. The uniformity of temperature attained depends on the proper design of the heating equipment. Continuous and horizontal and vertical batch-type furnaces are described. The air heaters may be direct or indirect gas-fired or may be electrical. —W. A. C. N.

**Air Heaters for Convection Heating.** — (*Indust. Heating*, 1935, 2, 527–534).—Illustrated descriptions of various types of direct and indirect air heaters.—W. A. C. N.

**Graphite Resistor Radiation Furnaces and Their Applications to High Temperatures.** Henri George (*Trans. Electrochem. Soc.*, 1935, 68, 53–58; discussion, 58–63).—See *Met. Abs.*, this vol., p. 482.—S. G.

**Carbon and Graphite Electrodes.** F. J. Vosburgh (*Domez*, 1935, 7, (2), 96–97; *Ceram. Abs.*, 1935, 14, (11), 287).—[In Russian.] Briefly discusses historical data, methods of manufacture and graphitization, and uses of electrodes, the expenditure of electrode per ton of non-ferrous metals, ferro-alloys, steels, &c.—S. G.

**Why Not Use Inductive Electric Heating?** Charles E. Daniels (*Chem. and Met. Eng.*, 1935, 42, 325–328).—Technical details connected with the design of electrical induction heaters are discussed.—F. J.



**A Graphical Method of Calculating Heat Loss Through Furnace Walls.** Clarence E. Weinland (*Trans. Amer. Soc. Metals*, 1935, 23, 431-444; discussion, 444-454).—When a wide range of temperatures is considered, difficulty is encountered in representing accurately the thermal conductivity of a material whose temperature function is not a straight-line relation. This difficulty can be obviated by the use of the "true" conductivity function as defined in this paper. The "true" conductivity function confers the additional advantage that it makes possible a graphical method for calculating heat transmission through compound structures under conditions of equilibrium heat flow. Though this is still a trial and error method, it is much more convenient and direct than any method heretofore proposed for dealing with this type of problem. The method is illustrated by the solution of a typical problem.—S. G.

**Changing Aspect in the Competitive Market for Industrial Fuels.** H. O. Loebell (*Amer. Gas Assoc. Proc.*, 1933, 607; *Ceram. Abs.*, 1935, 14, (11), 287).—A questionnaire to men in industry revealed that gas may command a premium over other fuels on a B.t.u. basis. Gas has a distinct advantage owing to its cleanliness, ease of control, and automatic application in equipment designed and installed to develop these values. A discussion covers the questions: (1) is the trend in competing fuels going to higher prices?, and (2) can the gas industry reduce its costs and rates?—S. G.

**Temperature and Latent Energy in Flame Gases.** W. T. David (*Phil. Mag.*, 1936, [vii], 21, 280-282).—The steadily-maintained temperature, in a gaseous explosion, measured by a thin platinum-rhodium wire is many hundreds of degrees centigrade below the ideal temperature of the flame gases; it is inferred that there exists in flame gases a long-lived latent energy of considerable amount. Examples of gaseous mixtures for which the ideally calculated flame temperature is 1900° C. show that the measured steadily-maintained temperatures range from 1390° to 1745° C. and the latent energies from 8 to 28% of the heat of combustion. Similar results are given for mixtures for which the measured temperature is 1500° C.—J. S. G. T.

## XVI.—REFRACTORIES AND FURNACE MATERIALS

(Continued from p. 628.)

**Refractories from a Metallurgical Viewpoint.—I-IV.** G. E. Seil (*Indust. Heating*, 1935, 2, 517-521, 538-540, 587-590, 651-653, 713-717).—Refractories are said to consist of two parts, one crystalline in the form of grog which is relatively more infusible than the second which is the bond and is usually a glass. S. reviews the modern conceptions of the constitution of refractories. A series of photographs showing the transformation of quartz into cristobalite, tridymite, and wollastonite at high temperatures is given. In metallurgical service silica refractories have the peculiar characteristic of developing a coating of amorphous silica which has very definite and desirable properties in the refractory field. The magnesites have a grog of crystallized magnesia containing absorbed iron oxide bonded with various glasses. The changes in the latter with temperature introduce difficulties in manufacture. A large section is devoted to a study of chrome ore, whose two constituents are chromite (75-90%) and magnesium silicate, sometimes contaminated with small amounts of iron, alumina, and boron. The least physical change on heating occurs when the chromite crystals are small and surrounded by infinitesimal layers of the secondary material. A comparison is made between the petrographical characteristics of refractories and the microscopical ones of steel. Stress is laid on the necessity for laying refractory bricks in cement having similar properties to their own. A photomicrographic study of refractories is given.

A special apparatus is described for obtaining accurate data on the expansion of full-sized bricks.—W. A. C. N.

**Monolithic Linings for Induction Furnaces Melting Non-Ferrous Metals.** P. S. Kingsley (*Metals and Alloys*, 1933, 4, 59–62).—The most satisfactory method of ramming the refractory cement lining into Ajax-Wyatt induction furnaces is described in detail. The cement should be of a moist sandy consistency and should be rammed in small portions at a time by means of a No. 300 Ingersoll-Rand riveting hammer using 100-lb. air pressure. After air-drying the wooden core is burnt out by an electrical resistance strip previously inserted in the core; the lining is then heated to 95° C. for 48 hrs., and finally to 205° C. by means of the same resistor. Burning of the lining is preferably carried out with a torch of special construction.—A. R. P.

**Production of Bottom Brick for Ajax-Wyatt Electric Furnaces.** — (*Vakhrashev. Zitein-So*, No. 26,377 (Ser. 61); *Referatkartei Silikatliteratur* No. 1098, 1934; *C. Abs.*, 1936, 30, 585).—Ural flint containing silica 97.45, alumina 0.90, ferric oxide 1.27, magnesia, lime, titanium dioxide, trace, and with loss on ignition 0.04% was used for refractories for Ajax electric furnaces. They withstood 2000 brass and red brass melts. Details of production are given.—S. G.

**Refractories for Foundry Use.** W. J. Rees (*Found. Trade J.*, 1935, 53, (987), 47–48).—Read before the Institute of British Foundrymen. Modern furnace practice demands refractory linings which combine high-temperature resistance, refractoriness under load, resistance to abrasion and corrosion, and a wide deformation range. The special qualities of rammed linings are discussed, and a melting-point diagram of the alumina-silica series is reproduced. Curves show the refractoriness under load of firebrick and cupola brick. The importance of careful jointing is emphasized, and the necessary qualities of patching materials are enumerated.—P. M. C. R.

**Refractories for Foundry Use.** W. J. Rees (*Refractories J.*, 1935, 11, 423–424, 427–428).—See *Met. Abs.*, this vol., p. 608.—A. R. P.

**Refractory Materials, Types, Properties, and Industrial Application.** A. J. Dale (*J. Coventry Eng. Soc.*, 1935, 16, (2), 34–53).—A review lecture, referring to the varied conditions under which refractories are used and the principles guiding selection. The various types of refractory and their properties are described, including refractoriness under load, and curves are given. The discussion dealt with a number of practical questions.—R. G.

**Super Refractories.** Frank J. Tone (*Trans. Electrochem. Soc.*, 1935, 68, 22–26).—A brief review of the development of special refractories.—S. G.

**Insulating Refractories.** G. A. Bole (*Amer. Refract. Inst. Tech. Bull.* No. 51, 1934, 8 pp.).—The advantages and disadvantages of insulating refractories are tabulated and discussed. The chief advantages are a very marked saving in heating up time and in fuel costs, and a reduction in weight which makes possible a more satisfactory furnace construction. On the other hand the cost of the bricks is greater than that of heavy refractories owing to the greater difficulty of manufacture and the larger proportion of rejects. Care should be taken in selecting light-weight refractories since many brands now marketed are too permeable, too weak both cold and hot, shrink excessively, and are too dense for good heat insulation, and spall too readily.—A. R. P.

**Insulating-Refractory Lined Furnaces.** J. G. Coutant (*Indust. Heating*, 1935, 2, 522–524).—The combination term insulation-refractory is applied to refractories which imprison the useful radiant heat of the fuel near its source. It is said that furnaces lined with such materials can be lighted and put out without incurring such losses as are sustained in ordinary fire-brick lined furnaces; they can also be brought to working temperature in about one half the time.—W. A. C. N.

**On Hydraulic Hardening Refractory Masses.** W. Graf Czernin (*Ber. deut. keram. Ges.*, 1934, 15, 463-471).—The composition and properties of various refractory cements are given and discussed.—A. R. P.

**Refractories.** D. Dixon (*Steam Engineer*, 1934, 3, 149-150, 204-206).—A summary of the properties and occurrence of the most important furnace refractories is followed by a discussion of the properties of the ideal refractory for furnace settings. The reversible thermal expansion of high-grade aluminous fireclay, siliceous fireclay, and fused silica are tabulated for temperatures between 50° and 1250° C. Typical forms of cracking due to sudden heating or cooling are illustrated. In connection with the resistance of refractories to slag attack, a table gives descriptions and analyses of the ash produced by 10 types of coal, with melting and softening points in some cases. The condition of the surface of refractories after overheating, or penetration (physical, chemical, or combined) is illustrated, and the chief factors determining wear are summarized.—P. M. C. R.

**\*Reaction Temperatures Between Various Types of Refractory Brick.** Raymond E. Birch (*Amer. Refract. Inst. Tech. Bull.* No. 52, 1934, 11 pp.).—Since in many industrial furnaces different types of refractory brick come into contact with one another at high temperatures, the temperatures at which these refractories interact with one another were determined. Silica bricks do not react with chromite bricks, but react vigorously with magnesite brick at 1600° C. and with forsterite ( $2\text{MgO} \cdot \text{SiO}_2$ ) brick at 1700° C. Fireclay bricks do not react with 70% alumina (diaspore) bricks, but serious action occurs at 1500° C. with magnesite brick, and at 1600° C. with forsterite, and slight reaction at 1500° C. with silica brick and at 1600° C. with chromite brick. Diaspore brick reacts with chrome brick at 1600° C. and with forsterite at 1700° C. but magnesite reacts with neither of these bricks.—A. R. P.

**Properties of Refractory Materials Not Including Fireclays.** S. M. Phelps (*Amer. Refract. Inst. Tech. Bull.* No. 57, 1935, 5 pp.; and *Indust. Heating*, 1935, 2, 359-362).—The composition, melting point, sp. gr., hardness (Mohs' scale), specific heat, and thermal expansion of, *inter alia*, chromite, corundum, spinel, periclase, silica, carborundum, sillimanite, zircon, and zirconia are tabulated and thermal conductivity curves are given for some of these.—A. R. P.

**Properties and Applications of Modern Refractories.** W. F. Rochow (*Chem. and Met. Eng.*, 1935, 42, 76-80).—A paper (abridged) read before the American Institute of Chemical Engineers.—F. J.

**The Permeability of Refractory Materials to Gases.** — (*Amer. Refract. Inst. Tech. Bull.* No. 49, 1934, 8 pp.).—A review of recent work.

—A. R. P.

**On the Permeability of Some Refractory Materials to Hydrogen [at High Temperatures].** W. Baukloh and A. Hoffmann (*Ber. deut. Keram. Ges.*, 1934, 15, 424-433).—Fused silica and porcelain are only very slightly permeable to hydrogen at temperatures up to 1300° C., the permeability decreasing rapidly with increase in wall thickness. Sintered corundum is appreciably permeable at all temperatures, but the permeability decreases with rise in temperature being at 1100° C. only about  $\frac{1}{3}$  that at 20° C.—A. R. P.

**Gas Permeability of Refractories.** N. Lozinskii and S. German (*Ukrain Nauch.-Issledovatel. Inst. Ogneuporov Kisloutuporov* 30, 1934, 24 pp.; *Referat-kartei Silikatliteratur* No. 1000, 1934; *C. Abs.*, 1936, 30, 588).—A simple apparatus for measuring the gas permeability of refractories is described. The coeffs. of gas permeabilities at room temperature of grog and silica brick fluctuated between 1.40 and 3.919 and 0.146 and 0.807 respectively. The difference in pressure was not more than 6 or 7%. Attempts were also made to determine gas permeability between 20° and 8000° C. It was found that an absolutely uniform heating of the sample is required when



measuring permeability at high temperatures, that the temperature of the gas must be determined before its conduction through the product, and that loss of gas must be prevented.—S. G.

**Heat Transmission Through Bare and Insulated Furnace Walls.** R. H. Heilman (*Trans. Amer. Inst. Chem. Eng.*, 1935, **31**, 165–191; and (summary) *Indust. and Eng. Chem.* 1934, **41**, 637–641).—F. J.

**A Discussion of Thermal Spalling of Fireclay Brick with Relation to Young's Modulus of Elasticity, Thermal Expansion, and Strength.** R. A. Heindl (*Amer. Refract. Inst. Tech. Bull.* No. 58, 1935, 7 pp.).—Variations in the results of thermal spalling tests may be due chiefly to differences in the modulus of elasticity of various parts of the brick. The tendency to spall is inversely proportional to the ratio of the moduli of rupture and elasticity and is increased by increasing the firing temperature of the brick and by a reduction in the grog content or in the porosity of the grog.—A. R. P.

**\*The Crystal Modifications of Zirconia. A Clear, Fused Zirconia Produced in the Sun Furnace.** Willi M. Cohn (*Trans. Electrochem. Soc.*, 1935, **68**, 65–71).—S. G.

## XVII.—HEAT-TREATMENT

(Continued from p. 629.)

**Progress in Heat-Treatment of Alloys Resulting from Structure Studies.** David F. McFarland (*Pennsylvania State Coll., Mineral Ind. Exper. Sta. Bull.* No. 14, 1934, 67–76).—S. G.

**The Heat-Treatment of Hardenable Aluminium Casting Alloys.** (Söhnchen.) See p. 672.

## XVIII.—WORKING

(Continued from pp. 629–633.)

**\*Production of Powdered Alloys of Low Melting Point.** R. W. Rees (*J. Inst. Metals*, 1935, **57**, 193–195).—A method is described for producing lead-base alloys in the form of powder. For this purpose advantage is taken of the pasty stage through which the alloys pass during solidification.—R. W. R.

**Cold-Roll Drives.** — (*Engineer*, 1935, **160**, (4152), 142).—Describes briefly a drive comprising a double reduction helical gear and a worm reducer for barring purpose. The former driven by an 85-h.p. motor and the latter a 15-h.p. motor. A coupling automatically cuts out the barring motor and gear when the barring motor is over-run by the main motor.—R. Gr.

**Electric Driving.** — (*Engineer*, 1935, **160**, 184–185, 210–212, 234–236, 258–259, 284–286, 310–312).—Detailed descriptions of motors and circuits for driving machines which include punches and rolling mills. Profusely illustrated.—R. Gr.

**Progress in the Investigation and Working of Plastic Shaping Processes.** E. Siebel (*Light Metals Research*, 1936, **4**, 198–199).—Summary of a paper in *Metallwirtschaft*, 1935, **14**, 893; see *Met. Abs.*, this volume, p. 629.—L. A. O.

**Silver Coinages.** S. W. Smith (*Rep. Roy. Mint (Lond.)*, 1934, **65**, 58–61).—An account is given of experimental work undertaken for the production of "blanks" for large coins containing silver 50, copper 40, nickel 5, and zinc 5% in one case, and silver 50, copper 40, and nickel 10% in another.—J. H. W.

**\*Relation Between Plastic Deformation in Deep-Drawing and Tensile Properties of Various Metals.** M. H. Sommer (*Trans. Amer. Inst. Min. Met. Eng.*, 1934, **113**, 273–291).—See *Met. Abs.*, 1934, **1**, 626.—S. G.

**\*Causes of Surface Roughness in Aluminium Utensils.** M. I. Kovarskiy, F. M. Fatkin, S. N. Chernjak, and V. V. Stankevich (*Metallurg (Metallurgist)*, 1935, (10), 43–49).—[In Russian.] Surface roughness in aluminium utensils is

caused by the use of large-grained metal for the stampings. The causes of large-grained structure are pointed out. The best method of annealing in laboratory conditions which guarantees a small-grained structure and complete absence of roughness on stamping, is a rapid uniform annealing in a saltpetre bath at 350°–400° C. In works' conditions annealing should take place in a muffle furnace and the temperature before charging increased to 430°–450° C. —N. A.

**The Secondary Hot Mechanical Working of Light Alloys.** V. M. Aristov (*Nimash (Bull. Sci. Res. Inst. Machine-Building and Metal-Treatment)*, 1935, (6), 37–47).—[In Russian.] The mechanical properties of forged and stamped Duralumin articles made from rod and sheet prepared by forging, rolling, or pressing depend on the mechanical deformation and the intermediate heat-treatment.—N. A.

**\*Hot-Working of Aluminium Alloys by Forging and Compression.** A. von Zeerleder, R. Irmann, and E. von Burg (*Schweiz. Archiv angew. Wiss. Tech.*, 1935, 1, 49–55).—An attempt has been made to ascertain the internal resistance to metallic flow of the following materials, during static compression: pure aluminium, Anticorodal, Avional, and brass (58% copper). Avional requires the greatest effort in compression. In practice the following hot-working temperatures are observed:

	Beginning of Working, °C.	Minimum Temperature, °C.
Pure aluminium . . . . .	480–520	280
Anticorodal . . . . .	460–500	300
Avional . . . . .	400–440	340
Brass . . . . .	600–800	...

The results of various dynamic tests using hammers or falling weights are described.—W. A. C. N.

**5-Ton Forging Manipulator.** — (*Engineering*, 1935, 140, 99–100).—A brief description of the manipulator.—R. Gr.

**\*Dynamic Compression of Lead Cylinders.** M. N. Bogomolova and N. F. Kunin (*Zhurnal Tekhnicheskoy Fiziki (J. Tech. Physics)*, 1935, 5, 771–775).—[In Russian.] In the static and dynamic deformation of lead cylinders by a falling weight the relation between the applied force ( $P$ ) and the final height of the cylinder ( $l$ ) is  $Pl^m = C$ .  $C$  is greater for dynamic than for static deformation, but  $m$  is unchanged. From this expression the increase of resistance to deformation for lead compressed at 2–3 m./second is 86%; this increase cannot be explained by external energy losses during the dynamic tests.—N. A.

**Continuous Lead Cable-Sheathing and Pipe-Forming Machine.** — (*Engineering*, 1935, 140, 412–415).—A continuous flow of lead can be maintained for any length of cable to be covered.—R. Gr.

**New Plant for Manufacture of Weldless Tubes by the Drawing Process.** Jean Marette (*Rev. Mét.*, 1935, 32, 233–244).—A comprehensive description of a large plant for production of solid-drawn tubes by the Wellman process. —H. S.

**On the Selection of Drawing Passes.** V. Zverev (*Metallurg (Metallurgist)*, 1935, (10), 50–53).—[In Russian.] A proposal to abandon the idea of compression in the solution of various problems of calibration in view of the practical inconveniences and complexity of correlation, and to make use of the idea of deformation. Deformation is defined as the natural logarithm of the relation between the original and final lengths. The use of the deformation idea simplifies the selection of cross-sections, as the general deformation of all

the passes is the sum total of the individual deformations of each separate pass. For practical work ordinary decimal logarithms may be used.—N. A.

**Notes on the Use of Back Pull in [Copper] Wire-Drawing.** Paul M. Mueller (*Wire and Wire Products*, 1935, 10, 419-426).—Back pull is an important factor in wire-drawing which must be taken into consideration in the analysis of power requirements for cascade drawing; its effect is to reduce the pressure with which the metal may be drawn to a new size and thereby to lower the parasitic friction and improve inherent low die efficiency. By a special construction of the drawing machine designed to control back pull, the power required in drawing may be reduced by about 25%; partial elimination of the friction in the die improves die life and maintenance costs and permits the use of new means of lubrication effecting further economies.—A. R. P.

†**Hard and Soft Copper Wire.** R. A. Schatzel (*Wire and Wire Products*, 1935, 10, 382-396).—The principles of casting, rolling, forging, and drawing copper wire are described, and the effect of these treatments on the structure and properties discussed. A large number of photographs of the macro- and microstructure of the metal during all the stages of heat and mechanical treatment and many curves and diagrams showing the changes in properties are included.—A. R. P.

\***The Effect on the Physical Properties of Bending Copper Wire of Different Grain-Sizes.** L. B. Barker and C. A. Bailey (*Wire and Wire Products*, 1935, 10, 375-377, 380, 452).—The 15° bending test shows accurately the effects of bending and annealing on copper wire after quite small amounts of cold-work, whereas the elongation test offers no reliable indication of the changes occurring when annealed wire is slightly cold-worked. The stiffness of copper wire bent round a form of given diameter depends on its initial hardness; the bending increases the stiffness of annealed wire and decreases that of very hard wire. The stiffness decreases with rise in annealing temperature up to 700° C. and then increases again. Wire annealed at about the recrystallization temperature may meet all specifications as regards tensile strength and elongation and yet be unsatisfactory from the point of view of stiffness.—A. R. P.

**The Manufacture of Resistance Wire.** — (*Wire Ind.*, 1934, 1, 173, 175; and *Draht-Welt*, 1934, 27, (51), 803-804).—The compositions and properties of suitable alloys are described and the appropriate drawing conditions are indicated. The compositions recommended are 80 : 20 nickel-chromium and 65 : 15 : 20 nickel-chromium-iron.—P. M. C. R.

**The Production of Nichrome.** — Belezkiy (*Uralskaia Metallurgia (Metallurgy of Urals)*, 1935, (1), 29-32).—[In Russian.] Describes the production of Nichrome from melting to the manufacture of wire and ribbon in Russian works.—N. A.

**Diamond Dies.** — (*Wire and Wire Products*, 1935, 10, 194-195, 202-203, 204, 270-271, 292).—The development of the diamond die is briefly reviewed and modern methods of manufacture outlined.—A. R. P.

\***On the Problem of Producing Hard Alloys with a Tungsten Carbide Basis by the Method of Hot-Pressing.** B. A. Borok and N. M. Zarubin (*Nimash (Bull. Sci. Res. Inst. Machine-Building and Metal-Treatment)*, 1935, (4), 28-35).—[In Russian.] Hot-pressing is technically and economically unprofitable for hard alloys with a relatively low-melting bond, but it can be rationally applied for the production of hard alloys of the cast type. The hardness and tenacity of hot-pressed alloys are higher than those of cast alloys.—N. A.

\***Experiments on Preparing Plated Brass Ingots [Bimetal].** M. P. Slavinskiy, V. J. Marzinchik, and A. E. Vol (*Metallurg (Metallurgist)*, 1935, (5), 108-114).—[In Russian.] Brasses with 30% zinc cast at 950°, 1120°, or 1200° C., and with 40% zinc cast at 950°, 1020°, or 1100° C. were coated with brass 0.2 mm. thick or with copper, iron, aluminium, or zinc of various thicknesses from 0.002 mm. to 0.5 mm. The welding of the ingot to the plating sheet may be



hindered by the formation of zinc oxide, but this may be avoided by heating the moulds and by the use of a special lubricant which prevents oxidation. Thin aluminium and zinc coatings do not adhere evenly to the surface of the ingot, but iron coatings may be easily welded to brass ingots.—N. A.

**Drilling Copper Tube Plates.** — (*Engineer*, 1935, 160, (4169), 58-60).—Notes on the operation, illustrated with diagrams and tables. Peripheral speeds of drills advocated are 130-150 ft. per minute.—R. Gr.

**The Different Causes of Breakage in Circular Saws for Cutting Metals.** — (*Pratique Indust. mécaniques*, 1935, 18, (1), 25-26).—Breakage may be due to wrong mounting, bad handling, or to lack of uniformity in the material, the last-named being most frequent in the case of non-ferrous alloys. Methods of obviating mistakes in setting and handling are discussed.—P. M. C. R.

## XIX.—CLEANING AND FINISHING

(Continued from pp. 633-634.)

**Physico-Chemical Cleaning of Metals [Prior to Electrodeposition].** E. Jimeno and I. Grifoli (*Anales Soc. españ. Fis. Quím.*, 1932, 39, 794-806).—S. G.

**Finishing of Metal Surfaces.** Rudolf Plücker (*Metallwaren-Ind. u. Galvano-Tech.*, 1935, 33, 478-481).—See *Met. Abs.*, this vol., p. 634.—A. R. P.

**Notes on Polishing and Buffing Special Metals.** R. S. Leather (*Platers' Guide*, 1935, 31, (8), 19-20).—Notes are given on the buffing of cadmium, gold, pewter (dull and bright finishes), platinum, lead, lead-antimony, Britannia metal, and sheet tin.—J. H. W.

**How Attractive Finish Helps Metal Productions Sales.** 13.—**Polishing and Buffing.** Herbert R. Simonds (*Iron Age*, 1934, 133, (11), 16-19).—The advantages of polishing, and the data that are required to make the operation successful are set out. The method of polishing and buffing is described which will give reduced cost and the most satisfactory results according to various requirements.—J. H. W.

**Abrasives.** V. L. Eardley-Wilmot (*Mineral Ind.*, 1934, 43, 1-12).—The sources and production of natural and manufactured abrasives are discussed, with some statistics.—S. G.

**How Attractive Finish Helps Metal Productions Sales.** 17.—**Pre-Finished Raw Materials.** Herbert R. Simonds (*Iron Age*, 1934, 133, (19), 17-20).—The use of pre-finished raw materials, such as plated and polished strip, reduces costs by abolishing the finishing operation. The nature of the pre-finished material available and the manner of its application are described.—J. H. W.

**How Attractive Finish Helps Metal Productions Sales.** 19.—**Colouring Aluminium.** Herbert R. Simonds (*Iron Age*, 1934, 133, (24), 18-21).—An unusual method of colour application involves the forming of a dyeable oxide coating on the metal surface. The metal is the anode in an electrolytic tank, having a special electrolyte (composition not stated). With the correct current density and composition of the electrolyte, a coat is produced with the right amount of porosity to take a dye permanently throughout its depth. The applications of this process are discussed.—J. H. W.

**Metal Container Finishing.** Henry F. Frank (*Indust. Finishing (U.S.A.)*, 1935, 11, (6), 18-20).—An account of the lacquering and decoration of collapsible tubes and tinsplate.—C. E. H.

## XX.—JOINING

(Continued from pp. 634-638.)

**\*The Penetration of Brass Solder into Steel as a Consequence of Hydrogen Absorption During Pickling.** Peter Bardenheuer and Heinrich Ploum (*Mitt. K.-W. Inst. Eisenforschung*, 1934, 16, 137-140).—When mild steel is pickled in

dilute sulphuric acid and then immersed in molten brass the latter penetrates fairly deeply into the steel owing to the formation of intercrystalline cracks, i.e. the hydrogen adsorbed in pickling acts in the same way as internal stress in causing intercrystalline fracture. Penetration also occurs if the hydrogen is first removed by a low temperature anneal, but not if a high temperature anneal (e.g. 10 hrs. at 750° C.) is given.—A. R. P.

**\*Comparative Soldering of Brass by Means of Alloys With and Without Tin.** J. Podolskiy (*Metallurg (Metallurgist)*, 1935, (10), 97).—[In Russian.] The tensile strength of soldered articles was studied in relation to the tin content of the solder. Tests were carried out on alloys: (1) tin 7, antimony 7.5, lead 85.5%; (2) tin 2, antimony 7, lead 91%; (3) antimony 8, lead 92%; (4) tin 63, lead 37%; (5) tin 50, lead 50%. The higher the tin content of the alloy, the greater is the tensile strength. Soldering with low-tin alloys is easier than with tinless ones. With a solder containing 7% tin, the number of cavities in a fracture are fewer than with a tinless solder.—N. A.

**The Development of Low-Melting Point Solders.** — (*Engineering*, 1935, 140, 686).—A brief review of the development and future tendencies of the compositions, &c., of solders.—R. Gr.

**Production and Application of Silver Solders.**—I-II. Edmund R. Thews (*Engineer*, 1935, 160, 113-114, 136-137).—The compositions of silver solders and the effects of additional elements such as cadmium and nickel on the properties are described. The technique of the soldering process is also discussed.—R. Gr.

**Experiments in Ready-to-Solder Wire.** Burt M. McConnell (*Wire and Wire Products*, 1935, 10, 313-315).—The wire consists of a tube of solder with an inner core of tinned copper wire separated from the tube by a thin layer of rosin, the whole being manufactured by extrusion of the solder tube over a copper wire covered with molten rosin and cold-drawing the composite rod from  $\frac{1}{8}$  in. down to 0.04 in.; the resulting wire consists of solder 72, copper 23, and rosin 5%, and requires only to be touched with a hot soldering iron to make a perfect joint in contact with a clean terminal. The use of the material in the manufacture of radio sets and the like is briefly discussed.—A. R. P.

**Perfects Soldering Method at Low Heat for Aluminium.** — (*Daily Metal Reporter*, 1934, 34, (219), 6).—A brief note on two soldering compositions due to Johannson and reported by the U.S. Department of Commerce. "Redifal No. 1" may be applied to aluminium and light alloy sheet, and "Redifal No. 2" to light alloys and to stainless steel. No added metal is used.—P. R.

**Brazing Bits with Hard Alloys by Means of Natural Gas.** K. Mikhailov (*Azerbaidzhanoe Neftyanoe Khozyaistvo*, 1933, (2), 33-35; *C. Abs.*, 1934, 28, 6691).—[In Russian.] Bits were brazed with copper and Pobedit by means of natural gas and oxygen. Because of a lower temperature, the structure of the alloy was only little affected and the bit was more resistant. The hard alloy can be taken off dull bits and used again on new ones.—S. G.

**Practical Hints for the Gas Welding of Aluminium Vessels.** M. Majer (*Autogene Metallbearbeitung*, 1935, 28, 265-266).—Hints intended for welders who are not accustomed to aluminium. "Soft" or "hard" soldering is condemned on account of the susceptibility of the joints to corrosion.—H. H.

**Gas Welding of Aluminium Tank Structures.** G. O. Hoglund (*Indust. Gases*, 1935, 16, 30-33).—See *Met. Abs.*, this vol., p. 313.—H. W. G. H.

**\*A Contribution to the Question of Aluminium Welding.** S. Haarich (*Abhandl. Inst. Metallhütt. u. Elektromet. Techn. Hochschule, Aachen*, 1935, 3; and (abridged translation) *Light Metals Research*, 1936, 4, 209-210).—See *Met. Abs.*, this vol., p. 362.—J. C. C.

**The Welding of Aluminium by the Contact Electric Welding Machine ASZ-5.** T. V. Pesljak (*Autogennoe Delo (Autogenous Practice)*, 1935, (3), 26-27).—[In Russian.] The welding machine manufactured by "Electrik" Works is described.—N. A.

**\*An Investigation of the Welding of the New Aluminium Alloy BB.** T. T. Su rovzev (*Tekhnika Vosdushnogo Flota (Technology of the Aerial Navy)*, 1935, (6), 70-74).—[In Russian.] The superior mechanical properties obtained by heat-treatment are lost during welding, the tensile strength decreasing by 40-50%; subsequent heat-treatment, however, restores the mechanical properties, the tensile strength increasing to 85% of its initial value. Hints for preventing cracking are given. For gas welding the best flux consists of potassium chloride 14, sodium chloride 1.6, lithium chloride 30, potassium fluoride 7.5, and sodium sulphate 1 part. Welding is followed by a 30-minute anneal at 505° C. and quenching in cold water. The alloy contains copper 4.7-5.2, magnesium 0.5-0.7, manganese 0.8-1.2, silicon 0.6-0.8, and titanium 0.15-0.25%.—N. A.

**Recent Developments in the Welding of Aluminium Alloys.** D. I. Bohn (*Iron Steel Eng.*, 1935, 12, (1), 16-20).—A review of the special problems presented by the welding of light alloys, especially of the structural type, is followed by a description of modern methods, of arc, spot, seam, and butt welding.—P. M. C. R.

**\*Acetylene Welding of Electrolytic Copper.** L. Hunsicker (*Autogene Metallbearbeitung*, 1935, 23, 273-282, 289-297).—A long investigation of the properties of welds, made by oxy-acetylene with varied technique, in commercial electrolytic copper, is described. From tensile, Brinell, and notch-bar impact tests it is concluded that the use of the rightward process has no advantages. Grain-size determinations showed that annealing at 450°-500° C. had little effect, at 600°-700° C. the smallest grain-size was produced, and increasing grain-growth occurred at higher temperatures. Peculiar results at the surface of specimens were found to be due to the working produced by the machining operations. Corrosion tests were carried out in acetic acid (liquid and vapour) by loss of weight and electrolytic potential measurements. The results are given for 100, 75, 50, and 25% acid at 20°, 60°, 80° C., and boiling point. The most severe attacks usually took place at the transition zone between weld and parent metal. In general, the welds most resistant to liquid acetic acid were produced with silver-containing filler rods and without any flux. Very variable results were obtained with acetic acid vapour: the amount of air present was found to be an important factor.—H. W. G. H.

**Influence of Cuprous Oxide on the Welding of Copper.** Fernand Gysen (*Rev. Univ. Mines*, 1934, [viii], 10, 425-428; and (abstract) *Mech. World*, 1935, 97, 254).—The strength of welded joints in copper made by the oxy-acetylene flame using as a filling rod copper with 0.115% phosphorus increases slowly with increasing cuprous oxide content of the copper to a flat maximum at 0.12% cuprous oxide. Hot hammering of the weld reduces its strength considerably whereas the use of borax as a flux improves the strength of the joint. The best flux is, however, a mixture of sodium chloride 28, trisodium phosphate 40, boric acid 30, and borax 2%; with this flux the cuprous oxide content of the metal has little effect on the strength of welded joints made in it.—A. R. P.

**Repairing Copper Locomotive Fire-Boxes from Modern Points of View.** H. Cramer (*Autogene Metallbearbeitung*, 1935, 23, 260-262).—Typical repairs are illustrated and described. Leakage at the ends of staybolts is prevented by welding in "Vorschuhe" of Cuprodur, or by welding the ends of ordinary copper staybolts to the copper wall of the fire-box. The latter method has been used on about 10,000 stays, and no leakages have been detected after about 40,000 miles of service. The next few years are expected to show which method is the more economical.—H. W. G. H.

**Welding Copper Pipes.** W. L. Kilburn (*Indust. Gases*, 1934, 15, 148-167, 199-217).—H. W. G. H.



**The Problem of Copper Welding.** Max Grempe (*Metallwaren-Ind., u. Galvano-Tech.*, 1934, 32, 213-215).—Difficulties met with in the welding of copper are discussed and practical hints are given for obtaining sound welds.

—A. R. P.

**The Welding of Nickel and Monel Metal.** — (*Indust. Gases*, 1935, 16, 98-102).—See *Met. Abs.*, this vol., p. 399.—H. W. G. H.

**The Welding of "Elkonayt" Insertions [in Motor-Car Construction].** M. M. Markov and L. K. Sushchevski (*Autogennoe Delo (Autogenous Practice)*, 1935, (8), 17-20).—[In Russian.] In the spot-welding of the chassis and body insertions of the hard alloy Elkonayt (copper 20-35, tungsten 78-84%) are brazed on with an alloy of silver 60-70, copper 20-26, and zinc 3-15% using a flux of borax containing 1.5% of a 3 : 1 : 1 mixture of copper, lead, and zinc oxides. The insertions are first "tinned" with the silver solder at 700°-750° C., then placed into holes in the electrodes and held for a certain time in the furnace at 700° C.—D. N. S.

**Repairs by Blowpipe to Zinc Pressure Castings.** — (*J. Soudure*, 1935, (5); and *Indust. Gases*, 1935, 16, 148).—Soft soldering and brazing are not recommended. Welding is carried out by the leftward oxy-acetylene method, using 10-15% excess of oxygen. The filler rods have the same composition as the castings—viz. zinc 88, copper 5, aluminium 7%. Careful cleaning is important, the welding should be carried out very slowly, and subsequent cooling should also be slow.—H. W. G. H.

**How to Bronze-Weld.** — (*Indust. Gases*, 1935, 16, 88-93).—See *Met. Abs.*, this vol., p. 400.—H. W. G. H.

**†Welding in Aeroplane Construction.** H. Sutton (*Aircraft Engineering*, 1935, 7, 178-180).—The scope and application of welding is discussed and results of investigations on the properties of welds are given. The paper deals mainly with welding of steels.—H. S.

**Welding in the Aeronautical Industry.** J. B. Johnson (*Symposium on Welding of Iron and Steel, Iron Steel Inst.*, 1935, 1, 433-441).—Non-ferrous materials mentioned are: Inconel, for parts operating at elevated temperatures; aluminium and 1.5% manganese alloy, for fuel, oil, and water tanks, cowling, &c.; 5% silicon-aluminium castings for flanges, inlets, &c., welded to tanks; magnesium alloys for tanks and seats. Oxy-acetylene and spot-welding are used on these materials.—H. W. G. H.

**French Specifications for Welding Metal.** — (*Welding Ind.*, 1935, 3, (11), 389).—Corrections and modifications to the specifications translated in *Welding Ind.*, 1935, 3, 251-254, 321-323, 326. See *Met. Abs.*, this vol., p. 636.

—H. W. G. H.

**The Story of Welding.** L. Sanderson (*Indust. Gases*, 1935, 16, 73-75).—An interesting, concise history of gas, arc, and resistance welding.—H. H.

**Welding Research in the United States.** W. Spraragen (*Symposium on Welding of Iron and Steel, Iron Steel Inst.*, 1935, 2, 251-261).—University, industrial, and government research, in progress and projected, is surveyed, and a plea is made for international co-operation.—H. W. G. H.

**More Uses for Air-Acetylene Flame.** — (*Oxy-Acetylene Tips*, 1935, 14, 202-204).—Applications are described of the air-acetylene blowpipe and enclosed-flame soldering bit for soldering copper dairy plant and sweating the fittings of the force-feed oil supply of paper machines.—H. W. G. H.

**\*Heating Effect of the Oxy-Acetylene Flame With Different Exit Velocities of the Burning Gas Mixture.** E. Streb and H. Kemper (*Autogene Metallbearbeitung*, 1935, 28, 262-265).—By temperature measurements and by noting the time required to bring the surface of a steel plate to melting, the most effective exit velocity of the gases was found to be about 220 m. per second.—H. H.

**Improving the Quality of Spot-Welds.** A. M. MacFarland (*Welding Eng.*, 1934, 19, (11), 15-17).—Some hints are given on improving the uniformity of

welds made with simple types of welding machine and an attachment is described for converting a stitch-welder to seam-welding.—H. W. G. H.

**The Energy Conversion in the Welding Arc.** — Sandelowsky (*Elektroschweissung*, 1934, 5, 178-179).—The distribution of heat energy in arc welding is estimated to be: (1) melting of electrode, about 17%; (2) melting of edges of seam, 9%; (3) arc radiation 15%; (4) heating of sheet, 29%; (5) conduction and radiation of sheet, 30%. The small proportion of the total heat required to melt the electrode is emphasized, and it is concluded that the oft-quoted "melting-off time" of an electrode has little meaning except in relation to the welding conditions. It is shown that all other factors being maintained constant, there is a definite speed of welding for which the "melting-off" value and the volume of deposited metal are at a maximum. Below this speed, the heat loss in the sheets to be welded increases, and, above it, the amount of heat required to melt the edges increases.—H. W. G. H.

**A New Method for the Investigation of the Transfer of Material Through the Welding Arc.** J. Sack (*Symposium on Welding of Iron and Steel, Iron Steel Inst.*, 1935, 2, 553-559).—Previous investigations are reviewed, and a method is described in which a series of shadow pictures of the metal transfer are obtained by X-rays,  $12\frac{1}{2}$  radiographs being taken per second on a moving film. By this method, the coating can be distinguished from the core, and the vapours surrounding the arc are not reproduced. For the results, the photographs in the original must be seen.—H. W. G. H.

**A.C. Welding Equipment.** — (*Engineer*, 1935, 160, (4151), 122).—To overcome the difficulty of starting and maintaining the arc when welding with small currents, the no-load voltage must be relatively high. The incorporation of a choke coil in a certain electrical circuit permits of the correct no-load voltage being automatically obtained.—R. Gr.

**Electric and Gas Fusion Welding.** P. Bardtke (*Autogene Metallbearbeitung*, 1934, 27, 193-195).—The relative advantages of arc- and gas-welding are shown to have varied considerably as progress in the technique of one has outstepped that of the other process, and *vice-versa*. Although steel is primarily considered, it is pointed out that for small firms welding non-ferrous metals, gas-welding is to be preferred on account of its adaptability, although larger firms may be able to take advantage of the merits of the arc method in cases where these predominate.—H. W. G. H.

**The Development of Resistance Welding in France.** M. E. Languépin (*Symposium on Welding of Iron and Steel, Iron Steel Inst.*, 1935, 2, 227-236).—See also *Met. Abs.*, this vol., p. 637. The trend of design of resistance welders in France is reviewed. Spot-welders of high mechanical and electrical power are controlled by integrating wattmeter devices, compensating for variations in the work and in the supply voltage. Welding pincers are developed further than in other countries, but seam and upset welders are on the usual lines, although usually of more substantial construction and capable of higher operating speeds.—H. W. G. H.

**Some Theoretical Results in Electric Resistance Welding.** Marcel Mathieu (*Industrie elect.*, 1935, 44, 466-467).—See *Met. Abs.*, this vol., p. 636.—J. C. C.

**The Largest Universal Automatic Resistance Welding Machine and Its Forerunners.** E. Rietsch (*Tech. Zent. prakt. Metallbearbeitung*, 1935, 45, 296-299).—An illustrated article of a resistance welding machine which is capable of effecting joints between parts of 25,000 mm.<sup>2</sup> cross-section. It is said to be easily controlled.—W. A. C. N.

**Electric Seam-Welding Machines.** — (*Engineer*, 1935, 160, (4154), 190-192).—Gives a brief description of machines. The effect of current supply frequency, welding speed, &c., on the quality of the weld are also discussed.

—R. Gr.

**\*Contraction of Electrically Welded Seams.** E. Höhn (*Schweiz. Archiv angew. Wiss. Tech.*, 1935, 1, 86–91).—As in cast metals, contraction also occurs after autogenous welding. Generally the contraction occurs in every direction. A study was made of the contractions normal to and along the seam after electrical welding. The longitudinal shrinkage results in stresses along the length which may become very dangerous. The shrinkage normal to the weld results in curvature which interferes with later additions. The extent of the curvature is dependent on the weld profile and prior treatment. The conditions for the minimum effect were determined.—W. A. C. N.

**The Stress Analysis of Fusion Joints.** E. G. Coker (*Symposium on Welding of Iron and Steel, Iron Steel Inst.*, 1935, 2, 703–713).—Analyses of transverse fillet and butt welds are described, and it is suggested that X-ray and photo-elastic methods should be applied jointly. An appendix by A. E. H. Love gives a mathematical analysis of the stress distribution about a cavity in a tension member.—H. W. G. H.

**Experiments to Determine Welding Stresses.** G. M. Shaw and L. C. Percival (*Symposium on Welding of Iron and Steel, Iron Steel Inst.*, 1935, 2, 897–910).—Steel plates were butt-welded whilst “rigidly” held in such a way that contraction stresses transverse to the weld could be measured during and after welding. Electric arc and oxy-acetylene welds were compared. For the very complex results obtained, the detailed figures given in the original must be consulted.—H. W. G. H.

**Overstressing in Welded Joints.** H. Buchholz (*Welding Ind.*, 1935, 3, 267–271).—See *Met. Abs.*, this vol., p. 399.—H. W. G. H.

## XXI.—INDUSTRIAL USES AND APPLICATIONS

(Continued from pp. 638–646.)

**Light Metals and Their Alloys.** William M. Corse (*Indust. and Eng. Chem.*, 1935, 27, 745–751).—The history, early and present-day uses, production progress, and special advantages of aluminium and magnesium and their principal alloys are discussed. Curves show the relative world production of aluminium and of iron, lead, zinc, copper, and nickel on the bases of weight and volume. Although magnesium and aluminium compete with each other in industry, each is endowed with properties peculiar to itself and is complementary to the other in the field of chemical industries. Aluminium is superior in acid-resistance, magnesium in resistance to alkalis, certain organic chemicals, and most oils. To substitute one for the other in the chemical industry would be unwise.—F. J.

**The Economic Development and Importance of Aluminium.** H. G. Steck (*Schweiz. Archiv angew. Wiss. Tech.*, 1935, 1, 137–145).—See also *Met. Abs.*, this vol., p. 401. A historical outline of the technical and production development of aluminium.—W. A. C. N.

**The Use of Aluminium in the Cheese Industry.** G. Bonin (*Laiterie*, 1935, 41, 151–152).—See *Met. Abs.*, 1934, 1, 439.—H. W. G. H.

**Aluminium Possesses Wide Adaptability to Many Conditions and Requirements of the Food Industries.** J. R. Akers (*Food Ind.*, 1935, 7, 587–588).—General.—S. G.

**Aluminium Tubes for Cream.** — (*Food Manufacture*, 1935, (Jan.): and *Light Metals Rev.*, 1935, 1, 327).—Cream in tubular containers holding a sufficient quantity for one cup of a beverage are now marketed in Germany. They are made of aluminium foil, can stand upright, and are sealed somewhat in the manner of tooth-paste tubes. It is claimed that the contents will remain in first-class condition for 3 months. The tubes hold up to 70 grm. (2½ oz.).  
—L. A. O.



**Aluminium Tubes. Uses in the Textile Industries.** — (*Textile Mercury*, 1934, 91, 445; *J. Textile Inst.*, 1935, 26, 106A).—All-aluminium beams with adjustable flanges are now available and large quantities of aluminium tubing are used in the rayon industry for holding hanks in drying plants and rooms and also for carrying oil for lubricating purposes on cellulose acetate rayon spinning frames. Large quantities of aluminium tubing are also used in the construction of pins, bobbins, cheese carriers, guide and drafting rollers, safety guides for line shaftings, &c., for the rayon, cotton, and worsted industries.—S. G.

**The Use of Aluminium Castings in Large Arc Furnaces.** A. v. Zeerleder (*Light Metals Rev.*, 1935, 2, 193).—Summarized from *Aluminium*, 1935, 17, 529-530. See *Met. Abs.*, this vol., p. 639.—L. A. O.

**Aluminium and Its Alloys. With Special Reference to Transportation.** N. Warren Waterhouse (*J. Inst. Eng. Australia*, 1935, 7, (8), 295-304).—A comprehensive review dealing with history, ore distribution, production by different countries, alloys, specifications, manipulation and protection, and uses of the metal in transport. Applications in railway, highway, marine, and air transport are dealt with in detail.—R. G.

**Development in Automobile Metals.** D. H. Bramley (*Proc. Inst. Automobile Eng.*, 1934-1935, 29, 704-705).—Brief summary of a paper read before the London Branch of the Graduates' Section. Discusses the use of R.R. 50, Duralumin, and magnesium alloys, and the development in the manufacture and use of metal mixtures, particularly the modern group of cutting materials, including tungsten carbide, and a bearing material of bronze and oil. The difficulties in the manufacture of lead-bronze bearings have been overcome by centrifuging the metal into bearing shells and a description of the process is given.—L. A. O.

**Light Cylinders for Propane Transport.** — (*Chem. Trade J.*, 1935, 96, 440; and *Light Metals Rev.*, 1935, 2, 13).—In trials of new seamless light metal cylinders for compressed and liquified gases, cylinders intended to resist a normal pressure of 150 atm. successfully withstood tests of 300 atm. without distortion. Their use is suggested for propane gases.—L. A. O.

**Increasing the Carrying Capacity of the Oropa-Lake Mucrone Funicular Railway.** U. Carlevario and M. Hug (*Allègement des Transports*, 1934, 3, 55-59, 89-94).—The redesign of the passenger coaches, which are now constructed almost entirely of light alloys, is one of the methods by which the efficiency of the Oropa-Lake Mucrone aerial railway has been increased. Avional is used for almost all stressed members except axles, anti-vibration fittings, and wheels: of the latter the outer pair are of steel, and the remainder of cast Duralite discs connected by Avional bolts. The precautions observed in cutting, cold-bending, and riveting Avional members are described, as are the service and other tests on light alloy wheels previously heat-treated under various conditions. The total weight of a coach accommodating 22 persons is about 1200 lb. or about 60 lb. per passenger; this represents a 35% economy in weight as compared with the lightest vehicle of similar type previously in service.—P. M. C. R.

**Development and Trend of Rand Winding Practice.** Wm. Elsdon-Drew and J. J. P. Dolan (*J. S. African Eng.*, 1935, 33, (12), 265-289; and (summary) *Light Metals Rev.*, 1935, 2, (8), 123-125).—Part VIIa of the paper (pp. 284-285) deals with the economy in power and cable cost effected by the use of Duralumin skips and cages in the place of steel.—P. M. C. R.

**Inspection of [Aluminium] Tip of Washington Monument.** — (*Bur. Stand. Tech. News Bull.*, No. 212, 1934, 125; *Build. Sci. Abs.*, 1935, 8).—Except for slight damage to the tip, caused by lightning, an aluminium pyramid, 555 ft. above ground level, placed in position in 1884, was found to be in an excellent state of preservation when inspected in 1934. The surface was covered with a thin, grey, oxide coating, easily scraped off to

reveal the unaffected metal below. Engraved inscriptions were still clear-cut and sharp.—S. G.

**Aluminium-Surfaced Mirrors.** H. Spencer Jones (*Nature*, 1934, 133, 552-553).—Advantages of aluminium-surfaced mirrors are briefly referred to. For observations in the ultra-violet region the aluminium film is very much superior to the silver film; aluminium films are more firmly adherent to glass than are silver films. The largest mirror hitherto coated with aluminium is the 36-in. mirror of the Lick Observatory. The film is best deposited by an evaporation process. Speculum metal gratings can be coated with aluminium. Apparatus for aluminizing telescope mirrors up to 36 in. diameter is to be provided in England.—J. S. G. T.

**Aluminium-Surfaced Mirrors in Astronomy.** H. Spencer Jones (*Nature*, 1934, 134, 522).—It appears probable that aluminium-surfaced mirrors will, in time, entirely displace silvered mirrors for investigations in the ultra-violet region of the spectrum and for astronomical purposes generally. The mirrors are best produced by an evaporation process. Results obtained with a 36-in. and with a 15-in. aluminium-coated mirror are briefly referred to.

—J. S. G. T.

**Aluminium Alloy Bars for Machining and Extruded Sections.** — ((*Brit.*) *Air Min. Specification* No. D.T.D. 290, 1935, 3 pp.).—Covers the materials generally known as N.A. 24S alloy, Duralumin G, and Hiduminium 72 (sp. gr. not greater than 2.80).—S. G.

**Soft Aluminium Alloy Sheets and Strips.** — ((*Brit.*) *Air Min. Specification* No. D.T.D. 278, 1935, 3 pp.).—Covers the alloy generally known as "N.A. 4S" (sp. gr. not greater than 2.70).—S. G.

**Half-Hard Aluminium Sheets and Strips.** — ((*Brit.*) *Air Min. Specification* No. D.T.D. 266, 1935, 3 pp.).—Covers the alloys generally known as N.A. 4S, D. 2, and Birmabright II (sp. gr. 2.70).—S. G.

**Aluminium-Coated Aluminium Alloy Sheets and Strips.** — ((*Brit.*) *Air Min. Specification* No. D.T.D. 275, 1935, 5 pp.).—Covers the materials generally known as Alclad N.A. 24S alloy and Aldural G (sp. gr. not greater than 2.85).

—S. G.

**Aluminium Alloy Sand- or Die-Castings (Not Suitable for Pistons).** — ((*Brit.*) *Air Min. Specification* No. D.T.D. 264, 1935, 3 pp.).—Covers the alloy generally known as Birmasil Special.—S. G.

**Aluminium and Bauxite.** C. L. Mantell (*Mineral Ind.*, 1934, 43, 13-35).—Deals with production, imports and exports, with statistics.—S. G.

**Antimony.** — (*Mineral Ind.*, 1934, 43, 36-42).—Production prices, imports and exports are discussed, with statistics.—S. G.

**Arsenic.** — (*Mineral Ind.*, 1934, 43, 43-45).—Deals with production, prices, imports and exports, with statistics.—S. G.

**Barium and Strontium.** Charles Hardy (*Mineral Ind.*, 1934, 43, 59-62).—Discusses prices and production of the minerals and chemicals, with statistics, and briefly deals with advances in technology.—S. G.

**Recent Applications of Bismuth.** Jean Cournot (*Mem. Compt. rend. Soc. Ing. civils France*, 1935, 88, 396-405).—The minerals and metallurgy of bismuth are outlined, and the properties and former uses of the metal and the more recent applications of the binary, ternary, and quaternary alloys of bismuth with cadmium, lead, tin, and antimony are described.—J. H. W.

**[Cadmium-Base] Bearing Metals Containing Silver.** — (*Engineering*, 1935, 139, 284).—Cadmium-base bearing metals are stated to have improved qualities over tin-base bearing metals. The addition of silver to these alloys is further stated to be beneficial.—R. Gr.

**\*Cadmium-Magnesium Alloy Photo-Tubes.** L. R. Koller and A. H. Taylor (*J. Opt. Soc. Amer.*, 1935, 25, (6), 184).—Increase in concentration of magnesium in cathodes of cadmium-magnesium alloy (for ultra-violet radiation

tubes) was found to increase the relative response to long-wave radiation and *vice versa*.—R. G.

**Chromium.** — (*Mineral Ind.*, 1934, 43, 63-69).—Discusses prices, production, imports and exports, with statistics. Brief notes are given on advances in technology.—S. G.

**Cobalt.** C. W. Drury (*Mineral Ind.*, 1934, 43, 111-115).—Production and trade are discussed, with statistics. A bibliography of the technical literature, with references to some patents, is appended.—S. G.

**Copper.** Percy E. Barbour (*Mineral Ind.*, 1934, 43, 116-151).—Reviews the industry, with statistics of prices, production, consumption, secondary metal recovery in the U.S.A., imports, exports, &c., and progress in the principal mines. A brief bibliography refers to statistics and process metallurgy.—S. G.

**Utilization of Copper and Copper Alloys.** Wm. G. Schneider (*Mineral Ind.*, 1934, 43, 152-158).—A review for the year 1934. Statistics are given for shipments of brass and bronze ingots from the U.S.A., brass ingot prices (New York), copper, brass, and tube prices (U.S.A.), consumption *per capita* by various nations 1925-1934, estimated use in various industries in U.S.A., refined copper (N. and S. America), and deliveries by refineries.—S. G.

**Metallurgy of Copper in 1934.** Carle R. Hayward (*Mineral Ind.*, 1934, 43, 159-174).—Reviews technical advances.—S. G.

**Copper, Brass, and Bronze in the Food Industries.** Carter S. Cole (*Food Ind.*, 1935, 7, 583-584).—S. G.

**Copper Alloys in Food Manufacture.** James T. Kemp (*Food Ind.*, 1935, 7, 584).—S. G.

**Copper Staining [of Leather].** M. P. Balfe (*Leather World*, 1934, 25, 1139; *J. Amer. Leather Chem. Assoc.*, 1935, 30, 577; *C. Abs.*, 1936, 30, 322).—Copper introduced into the liquors largely by corrosion by chestnut extract is precipitated as sulphide by  $\text{Na}_2\text{S}$  carried over from the lime liquors. The presence of large amounts of sulphur dioxide in the liquors will prevent this precipitation.—S. G.

**Sheet Copper-Work for Building. A Practical Handbook.** — (*Copper Development Assoc. Publ. No. 5*, 1934, 69 pp.).—Deals with plain roofing work, incidental roofing details, rain-water goods, other uses for sheet and copper strip, light-gauge roofing, welding of sheet copper, corrugated copper, shingles or tiles, and the formation of patina or protective coatings on copper.—S. G.

**The Use of Copper for Domestic Water Services.** — (*Copper Development Assoc. Publ. No. 8* (6th edn.), 1935, 51 pp.).—A useful, illustrated publication dealing with the various advantages of copper for domestic water services. Comparisons are made with iron and lead as to properties and costs. Weight and gauge tables are included.—S. G.

**Copper Piping in Gas-Heated Hot-Water Systems.** H. A. Blum (*Cuivre et Laiton*, 1935, 8, 155-159).—From a study of the comparative thermal efficiencies of iron and copper piping systems, it is concluded that copper is superior to iron.—S. G.

**Cast Beryllium-Copper Moulds for Moulding Plastics.** — (*Modern Plastics*, 1935, Nov.; *Bull. B.N.F.M.R.A.*, 1936, (85)).—The Gorham Co. is developing the use of cast beryllium-copper moulds for moulding plastics. They appear to be specially suitable where ornamental surfaces are required in the mouldings. Advantages and disadvantages are frankly discussed. Steel moulds are at present in use.—S. G.

**Lead-Bronze Ingots and Bars (Suitable for Bearings).** — ((*Brit.*) *Air Min. Specification No. D.T.D. 274*, 1935, 1 p.).—S. G.

**Nickel-Containing Bronzes in the Automobile Industry.** L. Abbott (*Nickel Bull.*, 1935, 8, 99).—Describes the applications of a nickel-bronze containing



copper 88, tin 11.2, phosphorus 0.3, and nickel 0.5%, where considerable abrasion and heavy loads must be withstood.—J. H. W.

**Test Comparative Values of Worm-Gear Materials.** Chester B. Hamilton (*Inco*, 1935, 13, (3), 20).—A brief mention of practical wear tests, showing the value of chill-cast nickel-phosphor-bronze for gears.—R. G.

**Hard-Drawn Phosphor-Bronze Tubes (Suitable for Bushes).** — ((*Brit.*) *Air Min. Specification* No. D.T.D. 265, 1935, 2 pp.).—Covers the alloy generally known as Carobronze.—S. G.

**Brasses and Other Copper-Zinc Alloys.** — (*Copper Development Assoc. Publ.* No. 6, 1934, 46 pp.).—This is the first of a series of booklets on the brasses, prepared for engineers, and consists of a selection from the very large amount of information on these alloys, given in the form of an engineer's notebook, and intended as a guide in the specification of the alloys. The booklet deals briefly with the normal brasses (for cold- or hot-working; crystalline structure; colours; gilding metals, mechanical properties; cold-working and annealing; strength and mechanical testing; electrical and thermal conductivity); special brasses (lead-brasses; high-tensile brasses; manganese-bronze); temper-hardening, aluminium-brass; corrosion-resistance), joining brass; brass sheet and strip for pressing and deep-drawing; extruded sections. Useful tables and curves are included.—S. G.

**Practical Brass Pipe Plumbing.** T. N. Thomson (*Copper and Brass Res. Assoc. (U.S.A.)*, 1934, (2nd edn.), 43 pp.).—Practical recommendations are given for cutting, threading, and installation of brass piping in plumbing services.—S. G.

**Silicon-Brass Sheets (Annealed) (For Sheets Not Over 24 Inches Wide).** — ((*Brit.*) *Air Min. Specification* No. D.T.D. 263, 1935, 3 pp.).—Covers the alloy generally known as "J.B. 38A."—S. G.

**Silicon-Brass Sheets (Half-Hard) (For Sheets Not Over 24 Inches Wide).** — ((*Brit.*) *Air Min. Specification* No. D.T.D. 267, 1935, 3 pp.).—Covers the alloy generally known as "J.B. 38A."—S. G.

**The Primitive Use of Gold.** T. A. Rickard (*Bull. Inst. Min. Met.*, No. 360, 1934, 28 pp.).—The use of native gold for personal decoration by primitive peoples is discussed and the methods used for recovering the metal from alluvial sands and reef deposits are described; 87 references to accounts of the travels of ancient, mediæval, and modern explorers among aboriginal tribes are included.—A. R. P.

**Gold and Silver.** H. N. Lawrie (*Mineral Ind.*, 1934, 43, 186-294).—Discusses production, prices, shipments, stocks and economic questions, with statistics. Technical advances are reviewed. A bibliography is appended covering economic questions, mining, and metallurgy.—S. G.

**Lead.** Allison Butts (*Mineral Ind.*, 1934, 43, 362-383).—Discusses markets, price, production, consumption, imports and exports, smelter capacities, &c., with statistics.—S. G.

**Metallurgy of Lead in 1934.** Carle R. Hayward (*Mineral Ind.*, 1934, 43, 384-389).—Reviews technical progress.—S. G.

**Lead [in the Food Processing Industries].** F. E. Wormser (*Food Ind.*, 1935, 7, 586).—S. G.

**The Use of Lead in Buildings. Joints in Sheet Lead.** J. Mahul (*Sci. et Ind.*, 1934, 18, 349-350; *Build. Sci. Abs.*, 1934, 7).—Several examples are discussed, and illustrated, of the use of lead in the footings of ancient columns, and of sheet lead as bases, damp-proof courses and joints in the foundations, steps, and balustrades of masonry structure.—S. G.

**Note on the Reconstruction of Suspension Bridges in the Department of Loiret.** — Bachet (*Ann. Ponts Chaussées*, 1935, 105, (1), 77-132).—The reconstruction of 3 suspension bridges included an investigation of the part played by the capping alloy in the distribution of stresses in the cable sockets.

It was found that the alloys employed were sufficiently plastic to introduce an axial component into the shear stress acting on the sockets. The compositions in use are stated to be: (a) lead 88, antimony 5, zinc 7%; (b) lead 96.1, antimony 2.14, tin 1.24, other constituents 0.56%.—P. M. C. R.

**Oil-Saving and Oilless Bearings.** — (*Oel u. Kohle*, 1935, 11, 933-934).—P. M. C. R.

Discussion of a paper by Baum (*Met. Abs.*, this vol., p. 641).—P. M. C. R.

**\*Engine Lubrication with Different Bearing Metals.** C. M. Larson (*J. Soc. Automotive Eng.*, 1934, 35, 444-453).—See *Met. Abs.*, this vol., p. 487.—S. G.

**Magnesite.** Samuel H. Dolbear (*Mineral Ind.*, 1934, 43, 390-395).—Deals with world's magnesite production, &c., and with metal sales as new ingots or manufactured metal and imports for U.S.A.—S. G.

**Magnesium Alloy Castings.** — (*Brit. Air Min. Specification No. D.T.D. 59A*, 1935, 3 pp.).—Supersedes Specifications Nos. D.T.D. 59 and D.T.D. 40. The sp. gr. of these alloys is not greater than 1.83.—S. G.

**Magnesium Alloy Castings (Suitable for Pressure Work).** — (*Brit. Air Min. Specification No. D.T.D. 136A*, 1935, 3 pp.).—Supersedes Specification No. D.T.D. 136. The sp. gr. of these alloys is not greater than 1.83.—S. G.

**Magnesium Alloy Castings (For Lightly Stressed Parts).** — (*Brit. Air Min. Specification No. D.T.D. 140A*, 1935, 3 pp.).—Supersedes Specification No. D.T.D. 140. Castings to this specification should be used for fittings &c., which are welded on to structures made of magnesium alloy sheets to Air Ministry Material Specification No. D.T.D. 118. Sp. gr. of this alloy is not greater than 1.83.—S. G.

**Manganese.** — (*Mineral Ind.*, 1934, 43, 396-411).—Deals with production, prices, imports, reserves, mining, &c., with statistics. Brief notes are given on technology.—S. G.

**Quicksilver.** — (*Mineral Ind.*, 1934, 43, 509-515).—Production, prices, imports and exports are discussed, with statistics.—S. G.

**Molybdenum.** Alan Kissock (*Mineral Ind.*, 1934, 43, 417-420).—Discusses market, production and prices, with statistics.—S. G.

**Nickel.** Thos. W. Gibson (*Mineral Ind.*, 1934, 43, 421-428).—Discusses sources, Canadian deposits, uses and technology. Statistics are given for U.S. imports and exports, Canadian production and exports, secondary metal recovery in U.S.A., and minor production in other countries.—S. G.

**Nickel and Its Alloys [in Food-Processing Equipment].** F. L. La Que (*Food Ind.*, 1935, 7, 580-582).—S. G.

**Metal Replaces Glass in Radio Tubes [Fornico].** — (*Metal Progress*, 1935, 27, (6), 32-37).—Envelopes of Fornico, a ductile alloy containing nickel 28, cobalt 18%, remainder iron, are now used instead of glass in the manufacture of radio valves. The thermal expansion of the alloy is almost identical with that of hard glass, which material is used as the insulator through which the leads (also of Fornico) are introduced. A similar alloy, Fernichrome, (nickel 30, cobalt 25, chromium 8%, remainder iron) may be used with softer glass. The use of metal envelopes permits greater precision in manufacture, whilst the pieces are more compact and robust than when glass is employed. Gas-tight joints are made by copper brazing or resistance welding. The final evacuation of the cells is effected by a "getter" alloy, usually magnesium-barium, which clears the sealed vessel of any gas molecules remaining after the usual evacuation process.—P. M. C. R.

**45 Per Cent. Nickel Alloy Rods, Wires, Tubes, Rivets, and Split Pins.** — (*Brit. Air Min. Specification No. D.T.D. 268*, 1935, 2 pp.).—The wire is suitable for locking wire and the tubes are for the production of tubular rivets.—S. G.

**Platinum Group Metals.** G. A. Roush (*Mineral Ind.*, 1934, 43, 460-473).—Reviews production, prices, supplies, consumption, imports and exports, &c., with statistics, and gives brief notes on advances in technology. A short bibliography is appended.—S. G.

**Precious Metals as Materials of Construction.** Fred E. Carter (*Indust. and Eng. Chem.*, 1935, **27**, 751-755; and (summary) *Met. Ind. (Lond.)*, 1935, **47**, 81-84).—The availability, uses, prices, properties, and chief industrial applications of platinum, iridium, osmium, palladium, rhodium, and ruthenium are discussed. Chemical equipment, catalysis, the rayon industry, furnace resistors, electrical contacts, electrodes, fuse wires, temperature indicators, electroplating, laboratory ware and composite metal are the chief fields of application of these metals, articles made from which have a longer life than those made from base metals and yield better products. The high re-sale value of the metals also helps to compensate for higher initial expense. The hardening effects of the other precious metals as well as of copper and nickel on platinum and palladium, also the effect of chemical reagents on the platinum metals are tabulated and illustrated diagrammatically. The applications of gold and silver are also briefly discussed.—F. J.

**Radium, Uranium, and Vanadium.** Hugh S. Spence (*Mineral Ind.*, 1934, **43**, 516-524).—Statistics and uses are discussed. A bibliography is given.—S. G.

**Silver-Plated Tableware.** — (U.S. Federal Specification RR-T-51a, 1934).—Supersedes No. RR-T-51, July 21, 1931.—S. G.

**Tin.** E. Baliol Scott (*Mineral Ind.*, 1934, **43**, 553-569).—Reviews prices, production, consumption, the international policy of restriction, and smelting.—S. G.

**Tungsten.** Colin G. Fink (*Mineral Ind.*, 1934, **43**, 570-583).—Discusses prices, production and trade, with statistics. Advances in technology are briefly dealt with. A bibliography is appended.—S. G.

**Comparing the Performance of Bits Brazed with Powdered Vokar and Pobedit.** N. L. Vartanesov and E. V. Chernuisheva (*Azerbaidzanskoe Neftyanoe Khozyaistvo*, 1933, (2), 20-33; *C. Abs.*, 1934, **28**, 6691).—[In Russian.] Vokar contains carbon 11.9, tungsten 84.7, iron 1.1, and silicon 0.3%; Pobedit contains carbon 5, tungsten 80.25, cobalt 8, molybdenum 1.86, and iron 5.24%. In drilling, Vokar produced much better results than Pobedit.—S. G.

**Pobedit as Contact Material.** S. V. Malatsenko (*Zavodskaya Laboratoriya (Works' Lab.)*, 1935, **4**, (3), 352).—[In Russian.] The copper contacts of the switches in machines for testing metal fatigue can be satisfactorily replaced by contacts of the hard alloy "Pobedit." Copper quickly wears out owing to the thousands of connections made every day.—D. N. S.

**An Application of a New Dense Tungsten Alloy in Teleradium Therapy.** L. G. Grimmett and J. Read (*Brit. J. Radiology*, 1935, [N.S.], **8**, 661-665).—The production of a tungsten alloy of density of about 16.5 gm./c.c. and its  $\gamma$ -ray absorption are described. An account is given of its use in the construction of an improved nosepiece for the 5-grm. teleradium apparatus of the Radium Beam Therapy Research at the Radium Institute, London.—S. V. W.

**\*Alloy Electrodes for Luminous Discharge Tubes and Their Applications.** J. B. J. Marcel Abadie (*Rev. gén. Élect.*, 1935, **37**, 627-633).—Electrodes for gas-discharge lamps are made by forming on the surface of a refractory metal such as iron, nickel, molybdenum, or tungsten an alloy with metals of the alkaline or alkaline earth series. This may be done by oxidizing a spiral of the refractory wire and plunging it, while red hot, in a mixture of salts of the alkaline metals. The coated wire is heated in air to decompose the salts to oxides, and then in a reducing atmosphere to convert them to metal. For heavy currents, calcium, strontium, or barium are preferred as the alloying elements; for smaller currents potassium, sodium, caesium, or rubidium may be used. The characteristics of tubes made with these electrodes are described. Advantages include long life, low energy loss, possibility of using only two electrodes, and wide range of discharge currents.—J. C. C.