

# METALLURGICAL ABSTRACTS

(GENERAL AND NON-FERROUS)

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## I.—PROPERTIES OF METALS

(Continued from pp. 425-429.)

\*On the Question of the Influence of the Surface Condition on the Endurance Limit of Aluminium Wires. Georg Richter (*Z. Metallkunde*, 1937, 29, (7), 214-217).—Tests carried out on the Wörnle fatigue-testing machine with aluminium wires with smooth and rough surfaces indicate that only sharp and deep notches reduce the fatigue limit; thus, impressions made with another similar wire act as stress concentration points, inducing fatigue fracture only when their depth exceeds 3% of the diameter of the wire, and a similar effect is produced by sharp scratches of insignificant depth. Impressions made with a pointed tool are less dangerous when shallow and more dangerous when deep than similar impressions made by filing.—A. R. P.

\*Limit of the Elasticity of an Aluminium Rod Composed of Comparatively Small Crystal Grains. Miyabi Sugihara (*Mem. Coll. Sci. Kyoto Imp. Univ.*, 1937, 20, (1), 27-33).—[In English.] In cold-worked commercial aluminium rods, heat-treated for a constant time, at temperatures above 200° C. and below the melting point, the crystal grains grow larger with increase of the heat-treatment temperature. With increase of annealing temperature, the elastic limit of aluminium decreases slowly at first from 603 kg./cm.<sup>2</sup> at 25° to 200° C., then rapidly from 200° to about 300° C., and then slowly to about 630° C., at which it attains the value 81 kg./cm.<sup>2</sup>. The elastic limit,  $L$ , expressed as elongation per unit length, is related to  $z$ , the grain number per unit length of test-piece, by the empirical relation  $L = L_0(1 - e^{-\alpha z})$ , where  $L_0$  is the value of  $L$  for  $z = \infty$ , and has the value  $8.88 \times 10^{-3}$ , and  $\alpha = 0.000151$ . The linear grain-size,  $Y$ , is related to the annealing temperature,  $T^\circ$  C., by the empirical relation  $Y = A(T - 200)^\dagger + B$ , where  $A = 0.73$  and  $B = -2.7 \times 10^{-3}$ .—J. S. G. T.

\*Elastic Limit of an Aluminium Rod and the Size of the Crystal Grains. Miyabi Sugihara (*Mem. Coll. Sci. Kyoto Imp. Univ.*, 1937, [A], 20, (4), 173-178).—[In English.] The limit of elasticity of an aluminium rod composed of a single crystal scarcely varies with the difference of orientation of the crystal. If it varies, the amount of variation is relatively small. In the case of rods composed of comparatively large crystals, the limit of elasticity decreases rapidly with increase of the linear crystal size, but after exceeding a crystal size of about 0.3 cm. it decreases very slowly. For the determination of the elastic limit of a rod composed of a large crystal, the method of gradually increasing loads is preferable to that in which the load is applied and removed repeatedly.—S. G.

[Discussion on Chaudron's Paper on] The Problem of the Elimination of Gaseous Impurities from Aluminium. — (*Found. Trade J.*, 1937, 57, (1103), 290).—Correspondence and reply (see *Met. Abs.*, this vol., p. 317).—H. H.

Melting Point of Chromium. C. J. Smithells (*Monthly J. Inst. Metals*, 1937, 4, (7), 352).—The melting point of chromium is above 1800° C., in contradiction of the frequently quoted figure 1550° C.—G. V. R.

Melting Point of Chromium. Frank Adcock (*Monthly J. Inst. Metals*, 1937, 4, (8), 441).—Cf. preceding abstract. High-purity chromium melts near 1830° C. *in vacuo*. Lower recorded values are possibly due to nitrogen contamination.—G. V. R.

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

† Denotes a first-class critical review.

**\*The Vapour Pressure of Copper and Iron.** A. L. Marshall, R. W. Dornic, and F. J. Norton (*J. Amer. Chem. Soc.*, 1937, 59, (7), 1161-1166).—The rates of evaporation of copper and iron were used to determine the vapour pressures of these metals. The accommodation coeff. for the two metals appears to be unity, which apparently establishes the validity of the Langmuir method. Direct determinations of the emissivities of iron and copper were made in conjunction with the vapour pressure study; the values are in agreement with previous reliable determinations.—S. G.

**Dissociative Adsorption of Hydrogen by Copper and Its Kinetic Consequences.** Loyal Clarke (*J. Amer. Chem. Soc.*, 1937, 59, (7), 1389-1391).—It is shown that the assumptions of dissociative adsorption on a uniform surface lead to kinetics which account for the observed equilibria in the primary activated adsorption of hydrogen on copper. The possibility of extension of these kinetics to rates, and to other systems, is discussed.—S. G.

**\*The Catalytic Union of Hydrogen and Oxygen on Copper and Copper-Gold Alloys.** A. B. van Cleave and E. K. Rideal (*Trans. Faraday Soc.*, 1937, 33, (5), 635-643).—At very low pressures at 170°-250° C., hydrogen and oxygen combine at a copper surface, with the formation of one molecule of cuprous oxide for each molecule of water formed. True catalytic union occurs only on surfaces coated with cupric oxide. The activated diffusion of oxygen apparently involves the transitory conversion of one molecule of cuprous oxide into a molecule of cupric oxide and an atom of copper; this is confirmed by experiments on copper-gold alloys.—A. R. P.

**\*An Improved Method of Purifying Europium.** Herbert N. McCoy (*J. Amer. Chem. Soc.*, 1937, 59, (6), 1131-1132).—S. G.

**\*[Atomic Weight of Europium].** G. P. Baxter and F. D. Tuemmler (*J. Amer. Chem. Soc.*, 1937, 59, (6), 1133-1134).—The atomic weight of europium, prepared by the method of McCoy (preceding abstract) was found to be 151.95.—S. G.

**\*On the Mechanism of Melting [of Gallium].** M. Volmer and O. Schmidt (*Z. physikal. Chem.*, 1937, [B], 35, (6), 467-480).—Very pure gallium was heated at just below the melting point, and a small portion of the surface exposed to the radiation from a small arc lamp. In certain circumstances, melting begins outside the irradiated spot, and proceeds parallel to crystal edges. It is suggested that melting does not begin in an ideal lattice but starts at spots which contain impurities or faults of some kind.—v. G.

**\*Further Experiments on the Minimum in the Resistance-Temperature Curve of Gold.** W. J. de Haas and G. J. van den Berg (*Physica*, 1937, 4, (8), 683-694; and *Comm. K. Onnes Lab. Leiden*, 1937, (249b)).—[In English.] In accordance with previous measurements (*Met. Abs.*, 1936, 3, 386), the resistance-temperature curves of the gold wires measured show a minimum. The influence of the annealing time remains confined to a shift of the minimum. A heating of the wire by the measuring current cannot be the cause of the minimum.—S. G.

**\*Optical Properties and Structure of Thin Gold Films.** P. J. Haringhuizen, D. A. Was, and A. M. Kruithof (*Physica*, 1937, 4, (8), 695-702).—[In English.] The reflectivity and transmission of gold films of known thicknesses were measured as a function of wave-length. The quantities  $n$  and  $k$  were determined from these experiments. For a thickness  $< 10\mu$   $n$  and  $k$  vary, owing to the decrease of the mean free path of the free electrons. The light-absorption of the thinnest films is explained with the aid of the hypothesis that they consist of gold in the amorphous state. Some ultramicroscopic observations show that the colours of thin films cannot be explained on the basis of the idea of a colloidal structure of the films. Some results of recrystallization are discussed.—S. G.

**Production of Thin Gold Films.** Charles S. Gibson (*Nature*, 1937, 140,



(3537), 279–280).—Describes the production of gold films by the decomposition of compounds such as diethylmonobromogold, when dissolved in a solvent such as ethanol to which an alkali is added. Films of different thicknesses can be produced, and a polished surface results if conditions are correct.—B. C.

\***Researches on [Dental] Gold Casting.** W. E. Herbert and A. R. F. Thompson (*Proc. Roy. Soc. Medicine*, 1937, 30, (3), 245–262).—Experiments carried out on the casting of dental plates in various investments in a Solbrig press are described. Smooth castings up to 0.4% larger than the wax patterns are obtained in an investment consisting of a 3:1 mixture of cristobalite and plaster of Paris as well as in a proprietary investment containing finely divided copper. The porosity of the cristobalite investment is about half that of a similar investment containing silica instead of cristobalite, and this may account for the faulty castings often obtained with cristobalite investment. The time taken for the gold to fill the mould after closing the lid is about 0.1 second, and the time taken for it to solidify is about 1 second. An asbestos pad moistened with water develops a pressure of 12 lb./in.<sup>2</sup> in 8 seconds, but the pressure during casting never exceeds 3 lb./in.<sup>2</sup>; the maximum pressure is developed by a very wet pad and a very hot ring. By using a 3:1 mixture of methylated spirits and carbon tetrachloride, pressures up to 50 lb./in.<sup>2</sup> can be developed, but only the pressure developed in the first second is effective in casting. If contact of the molten metal in the crucible with the damp pad is avoided, the gold will solidify in the mould before the residue in the crucible freezes.—A. R. P.

\***Atomic Weight of Lead from Galena, Great Bear Lake, N.W.T., Canada.** John Putnam Marble (*J. Amer. Chem. Soc.*, 1937, 59, (4), 653–655).—The value found was 207.21.—S. G.

\***The Atomic Weight of Some Radiogenic Leads.** G. P. Baxter, J. H. Faull, Jr., and F. D. Tuemmler (*J. Amer. Chem. Soc.*, 1937, 59, (4), 702–705).—S. G.

\***The Oxidation of Magnesium in the Liquid State.** Robert Delavault (*Paris: Centre Documentation Univ.*, 1936, 94 pp.).—See review, *Met. Abs.*, this vol., p. 574.—S. G.

\***Magnetic Quality of Nickel Wire as Influenced by the Surface.** T. F. Wall (*Nature*, 1937, 140, (3536), 238).—Curves are given showing that the magnetization curves (V–H curves) for nickel wires that had received similar heat-treatment are influenced by the diameters of the wires; in particular, the greater the ratio of surface to volume, the less easily is the wire magnetized by low magnetic fields.—B. C.

\***An Improved Method for the Determination of Thermal Diffusivities. [Thermal Diffusivity of Pure Nickel.]** Chauncey Starr (*Rev. Sci. Instruments*, 1937, [N.S.], 8, (2), 61–64).—A sinusoidal variation of temperature is impressed on one end of a wire, and the thermal diffusivity of the wire is determined from the measured decrement of temperature travelling along the wire. The thermal diffusivity of pure nickel, at 25° C., is found to be  $0.15885 \pm 0.00009$  cm.<sup>2</sup>/sec.; the corresponding thermal conductivity is 0.618 watts/cm. ° C.

—J. S. G. T.

\***The Promotion of Nickel Layers by Oxygen.** K. Ablesowa and T. Zellinskaja (*Acta Physicochimica U.R.S.S.*, 1937, 7, (1), 121–126).—[In English.] The catalytic action of nickel in effecting hydrogenation of ethylene is increased by oxygen; this promoting action is apparently attributable to a breaking up of the structure of the metal lattice.—J. S. G. T.

\***Effect of Occluded Hydrogen on the Rigidity of Metals [Palladium].** Joseph Lynch (*Nature*, 1937, 140, (3539), 363).—The effect of occluded hydrogen on the rigidity of palladium was studied by a resonance torsion method, which is described. The results quoted show that the normal rigidity of palladium may be increased by 12% by heating the metal electrically to expel hydrogen, and decreased by 14% by causing occlusion to occur.—B. C.

\***The Effect of Pressure and Temperature on the Occlusion of Hydrogen by Palladium.** E. A. Owen and John Idwal Jones (*Proc. Phys. Soc.*, 1937, 49, (5), 587-602).—The occlusion of hydrogen by palladium was studied by X-ray analysis. The lattice parameter, ( $A$ ), of palladium, in an atmosphere of hydrogen at pressures, ( $P$ ), of 0-76 cm. of mercury, was determined at 80°-160° C. At constant temperature a linear relation exists between  $A$  and the pressure for both phases in the system. For dilute solutions of hydrogen in palladium the change in  $A$  due to the occlusion of hydrogen varies directly as  $P$  and inversely as  $T^2$ . The entrance of hydrogen atoms into the palladium lattice loosens the bonds between the palladium atoms. The parameter of pure palladium, free from gas, at 20° C. has the value  $3.8825_6 \pm 0.0003$  A., and the mean coeff. of thermal expansion at 0°-300° C. equals  $12.7 \times 10^{-6}$  per ° C.—J. S. G. T.

\***The Palladium-Hydrogen System.** E. A. Owen and John Idwal Jones (*Proc. Phys. Soc.*, 1937, 49, (5), 603-610).—The hysteresis effect observed in the palladium-hydrogen system when the pressure of the gas is taken through a cycle was studied by X-ray analysis. When the pressure was increased, at 100° C., the  $\alpha$ -phase alone appeared at pressures, ( $P$ ), up to about 20 cm. of mercury, the parameter, ( $A$ ), increasing with increase of  $P$ . Between pressures of 20 and 45 cm. the  $\alpha$ - and  $\beta$ -phases appeared together, and on further increase of  $P$  the  $\beta$ -phase appeared alone. With decreasing pressures, starting from  $P = 66$  cm., the  $\beta$ -phase appeared alone until  $P = 21$  cm. Between pressures of 21 and 17 cm. the  $\alpha$ - and  $\beta$ -phases appeared together, and thereafter the  $\alpha$ -phase alone remained as  $P$  was reduced to zero. The parts of the ascending or descending isothermals in which a single isothermal existed, could be retraced by altering the pressure, but this reversibility disappeared when the second component occurred. The concentration of hydrogen in palladium changed rapidly when the  $\beta$ -phase appeared or disappeared. The palladium-hydrogen system consists of two solid solutions at 100° and 120° C., the hydrogen-rich phase being closely associated with the combination  $\text{Pd}_2\text{H}$ , which is capable of taking hydrogen into solution. The  $\beta$ -phase was always distorted; no distortion was found with the  $\alpha$ -phase. It required a temperature well above that necessary to displace the hydrogen to remove the distortion.—J. S. G. T.

\***The Heat Capacities of Selenium Crystals, Selenium Glass, and Tellurium at Low Temperatures.** C. Travis Anderson (*J. Amer. Chem. Soc.*, 1937, 59, (6), 1036-1037).—The heat capacities of selenium crystals and tellurium from about 50° to 300° K. were determined, and their corresponding entropies calculated as 10.49 and 12.85, respectively.—S. G.

\***Changes in the Density of Silver With Annealing and Cold-Working.** Atuomi Igata (*Mem. Coll. Sci. Kyoto Imp. Univ.*, 1936, 19, (5), 215-222).—[In English.] The effects of annealing and cold-rolling on the density of silver bars of cross-sectional area 4 mm.  $\times$  10 mm. was studied; the cold-rolling effected a reduction in thickness of about 50%. All densities were reduced to the equivalent value at 17° C. A maximum density characterizes an annealing temperature of 200°-300° C.; a minimum value occurs when the annealing temperature is 600°-800° C. The maximum increase of density is of the order  $5 \times 10^{-1}$ ; it is attributable to recovery from the initial internal stress. The disappearance of small cavities in the metal is largely responsible for the increase of density from the minimum value when the annealing temperature is 800°-900° C.; the cavities are responsible for the reduction of density characterizing annealing temperatures of 300°-700° C. A 60% cold-rolling is necessary in order to remove all the cavities. Specimens annealed at about 900° C. and devoid of cavities, show successive decreases of density when subjected to successive cold-rolling; specimens in which some cavities remain show an initial increase of density on successive cold-rolling. The density of



silver in a specified standard state at 17° C. is 10.502. (See also abstract below.)—J. S. G. T.

\***Changes in the Density of Silver by Cold-Hammering.** Atuomi Igata (*Mem. Coll. Sci. Kyoto Imp. Univ.*, 1937, 20, (1), 35–38).—[In English.] Cf. preceding abstract. The effect of hammering, applied at various stages of heat-treatment of a silver bar, on the density of the metal was studied. A 30–50% reduction in thickness produced a reduction of about  $4 \times 10^{-4}$  in the density. Recovery from this decrease is produced by annealing at 300°–400° C. Minute cavities in the metal are nearly all destroyed by hammering. Stretching causes a greater decrease of density than that caused by hammering or rolling.—J. S. G. T.

\***The Thickness of Silver Chloride Film Produced on the Surface of Silver Plate.** Shin'ichi Shimadzu (*Mem. Coll. Sci. Kyoto Imp. Univ.*, 1936, 19, (5), 229–236).—[In English.] A silver plate dipped in chlorine water becomes coated with silver chloride; the effects of concentration of the chlorine water, its temperature, and the duration of dipping, on the thickness of the coating were studied. When the thickness of the chloride coating attains a certain critical value, cracks occur in the coating; the larger the crystal grains of silver in the plate, the more difficult it becomes for these cracks to form.—J. S. G. T.

\***The Reflection and Absorption of Light by Partially Transparent Films of Silver and Aluminium.** A. Baxter (*J. Sci. Instruments*, 1937, 14, (9), 303–306).—Films of silver and of aluminium of varying thickness were prepared by evaporation *in vacuo*, and the reflection and absorption coeffs. of partially transparent films were measured for normal incidence. Three ranges of wavelengths were used, red light from 6000–7000 Å., green light from 4900–5600 Å., and blue light from 4300–4900 Å. Curves are reproduced showing the relation between the absorption and reflection coeffs. The silver films show marked colour selectivity which varies with density and age, but the aluminium films are fairly “grey” and stable at all densities. Aluminium gives a higher reflection coeff. and lower absorption coeff. than silver for blue light and also for green light, except possibly when the reflection coeff. lies between 50 and 75%. For red light, aluminium gives better reflection and lower absorption for reflection coeffs. below 55%, and silver gives greater values for higher densities. For “half-silvering,” where equal reflected and transmitted beams are required, aluminium always gives the higher percentage reflected and transmitted.—W. H.-R.

**Secondary Electron Emission from Oxidized Silver and Molybdenum Surfaces.** A. W. Afanasiewa and P. W. Timofeev (*Physikal. Z. Sowjetunion*, 1936, 10, (6), 831–840).—[In German.] Oxidation of silver and molybdenum surfaces reduces the secondary electron emission for almost all velocities of the primary electrons. In general, this decrease increases the greater the thickness of the oxidized layer.—J. S. G. T.

\***Changes in Shape of Heavily-Loaded Silver Contacts of Telecommunications Apparatus when Direct Currents are Switched On.** Wolfgang Krüger (*Z. Fernmeldelech.*, 1936, 17, (1), 1–13).—In automatic telephone apparatus, contacts making and breaking circuits carrying considerable currents are required to operate millions of times. Alterations of shape occur by: (1) fusion of contact metal and solidification in a different shape; (2) loss of metal by oxidation, evaporation, or sputtering; and (3) transfer of metal from one half of the contact to the other half. Tests are described in which silver contacts were operated 500,000 times, and the change of shape examined with a magnifying glass. The effect of connecting up non-inductive circuits, and of charging and discharging condensers, was examined under conditions of varying intensity. The results, including sketches of the appearance of the contacts, are tabulated and analyzed in some detail. The influences of

moisture in the atmosphere, of a slight impurity in the silver and of chatter of the contacts were also determined. (See also abstract below.)—R. T.

\***The Determination of Spark Quench Circuits for Contacts of Telecommunications Apparatus and the Valuation of Contact Metals.** Wolfgang Krüger (*Z. Fernmeldetech.*, 1936, 17, (2), 24–28; (3), 41–43; (4), 56–60).—From the data obtained in the first part of the dissertation (see preceding abstract), the resistance limits for spark quench circuits in non-inductive circuits to prevent harmful changes of shape of the contacts were calculated and confirmed by tests. Extensive tests with a circuit containing inductance, and a spark quench circuit, enabled current and voltage relationships to be established so that arcing or sparking at the contacts would be avoided. This gave a means of estimating the efficiency of a contact metal, and comparative tests placed silver between platinum and PGS (7% platinum, 68% gold, 25% silver), platinum being the most efficient. Inclusive of economic grounds, silver is considered a very good contact metal and, given correctly proportioned spark quench circuits, silver contacts can be heavily loaded.—R. T.

**Resistance of Silver Contacts.** G. Windred (*Elect. Ind.*, 1937, 37, (1899), 1141).—It appears probable that silver contacts retain their good conducting properties owing to the decomposition of the surface oxide (which is believed to have high resistivity) on local heating. This letter suggests that the problem warrants further investigation.—J. C. C.

\***The Elastic Constants of Crystalline Sodium at 80° K.** Sidney Siegel (*Phys. Rev.*, 1937, [ii], 51, (11), 1015).—Brief abstract of a paper read before the American Physical Society. The elastic constants of crystalline sodium at 80° K. were measured by the composite piezoelectric oscillator method of Balamuth and Rose. Observations are reported on 3 crystals whose axes lie approx. in the 100, 110, and 111 directions in the lattice. (See also abstract below.)—S. G.

\***The Elastic Constants of Crystalline Sodium at 80° K.** S. L. Quimby and Sidney Siegel (*Phys. Rev.*, 1937, [ii], 52, (6), 665).—A note. The elastic constants of sodium previously reported (Siegel (preceding abstract)) are erroneous, owing to the use of an incorrect formula. The correct values are given, but the high value of the compressibility suggests the presence of impurity, and the following elastic constants have been obtained from crystals grown from triply distilled Mallinckrodt sodium:  $s_{11} = 4.86$ ,  $s_{12} = -2.17$ ,  $s_{44} = 1.76 \times 10^{-11}$  cm.<sup>2</sup>/dynes at 80° K. The compressibility at 80° K. is  $1.56 \times 10^{-11}$  cm.<sup>2</sup>/dynes. Related physical constants are discussed.—W. H.-R.

\***Secondary Emission from Clean Tungsten.** Edward Coomes (*Phys. Rev.*, 1937, [ii], 51, (11), 1008).—Brief abstract of a paper read before the American Physical Society. The secondary electron emission from clean tungsten was studied over an energy range for primary electrons of 50 to 2000 v.—S. G.

\***Surface Migration of Barium [on Tungsten].** M. Benjamin and R. O. Jenkins (*Nature*, 1937, 140, (3534), 152).—B. and J. have repeated the experiments of Becker (*J. Inst. Metals*, 1929, 41, 433; and *Met. Abs.*, 1934, 1, 556), in which Becker found that barium, deposited on one side of a tungsten strip, could migrate to the other side. B. and J. find that when the thermionic emissions from the two sides are separated, there is no evidence for migration from one side to the other.—B. C.

\***A Study of the Properties of Hydrogen Films on Tungsten by the Method of Contact Potentials.** R. C. L. Bosworth (*Proc. Camb. Phil. Soc.*, 1937, 33, (3), 394–402).—The contact potential of a 92% covered surface of hydrogen on tungsten against bare tungsten is 1.04 v., and its Richardson constants are  $A = 30$ ,  $B = 5.60$  v. Other matters discussed include the process of production of atomic hydrogen at a tungsten surface, and the condensation coeff. (0.01) for hydrogen molecules on cold tungsten.—J. S. G. T.



\*Studies Relating to the Light of Combustion of Some Metals [Tungsten, Molybdenum, Tantalum, Cerium, and Carbon]. J. A. M. van Liempt and J. A. de Vriend (*Rec. trav. chim.*, 1937, 56, (1), 126-128; and *Laboratoria N.V. Philips' Gloeilamp., Separaat*, 1937, (1176), 126-128).—[In German.] The following values of the light output measured in lumen-sec. per mg. of metal burnt were determined: tungsten, 39.4; molybdenum, 68; tantalum, 185; cerium, 65; carbon, 63. The corresponding light outputs per watt generated in the combustion are: tungsten, 9.0; molybdenum, 8.7; tantalum, 32; cerium, 9.3; carbon, 1.9.—J. S. G. T.

Creep of Non-Ferrous Metals and Alloys. A Review of Published Information. W. A. Baker (*Brit. N.-F. Metals Res. Assoc., Research Rep., Assoc. Series*, 1937, (449), 20 pp.).—A summary of published information. The data have been selected critically, and include those for copper and its alloys, nickel alloys, aluminium and its alloys, and lead. The numerical values are tabulated, with compositions of materials. After each table is given a list of papers from which the data were obtained, with a note on the contents of each paper.—S. G.

\*The Properties of Metals at Elevated Temperatures. C. L. Clark and A. E. White (*Eng. Research Bull. Univ. Michigan*, 1936, (27), 100 pp.).—This booklet presents and correlates information relating to the properties of metal, principally steel and alloy steels, obtained at the University of Michigan since 1928. It comprises four major parts: (1) a discussion of the characteristics a metal must possess in order to render satisfactory service at high temperatures; (2) apparatus and method for determining these properties; (3) factors influencing creep characteristics; and (4) steels available for high temperature service, including a discussion of the calorizing process and the properties of calorized steels. The properties discussed include: creep-strength, short-time tensile and impact properties, oxidation and corrosion-resistance, and structural stability. Creep-resistance is shown to be a highly sensitive property, which is greatly influenced by many factors. Before reported creep values can be accepted as applying to another steel of approximately the same value, it must be ascertained that the complete history of the materials is the same. A bibliography of 21 publications, by the authors, on the subject is appended.—J. S. G. T.

\*Influence of the Rate of Extension on the Strength of Constructional Materials at Elevated Temperatures. I.—[Copper, Brass, and Aluminium and Its Alloys.] G. Welter and L. Oknowski (*Wiadomości Instytutu Metalurgii i Metaloznawstwa (Warszawa)*, 1937, 4, (1), 7-17).—[In Polish, with German summary.] The influence of extension-velocity on the strength of commercial metals and alloys at elevated temperatures was determined. This paper describes the results obtained for copper (99.9%), brass (60), aluminium, and its alloys. Cylindrical specimens 8 mm. in diameter and 5 cm. in length were tested in a 4-ton, hydraulically-loaded machine at temperatures between 20° and 520° C. for copper, 450° C. for brass, and 300° C. for aluminium and its alloys, after annealing for about 3 hrs. at higher temperatures. The apparatus was arranged vertically, and by suitable winding of the heating furnace the temperature variation over the short specimen could be kept within 2°-3° C., even at the highest temperatures. The times of fracture varied from 120 minutes to a few seconds, according to the material and the experimental temperature. (The results are accessible from tables and space diagrams.) In the case of copper, particularly in the range 300°-520° C., there is a simultaneous increase in tensile strength, elongation, and contraction of the diameter with decrease in fracture time, the work of fracture increasing correspondingly. At 300° C., the work of fracture for a fracture-time of 785 seconds was 830% of the value for a time of 6660 seconds, while at 520° C. the work of fracture for a time of 3 seconds was only 380% of that for a time of 3000 seconds. The

tensile strength of brass at 300° and 450° C. is also increased considerably by decreasing the fracture-time from 2 hrs. to a few seconds, the work of fracture increasing also, but in contrast to the behaviour of copper there is no determinable influence in the elongation or contraction of diameter. (See also abstract below.)—P. W. R.

**\*Influence of Rate of Extension on the Strength of Constructional Materials at Elevated Temperatures.** II.—[Aluminium, Duralumin, Lead, Tin]. G. Welter and L. Oknowski (*Wiadomości Instytutu Metalurgii i Metaloznawstwa*, 1937, 4, (2), 51–56).—[In Polish, with German summary.] Continuing previous work (on copper and brass, preceding abstract), W. and O. have studied the effect of rate of extension on the tensile strengths of aluminium, Duralumin at 20°–400° C., and of lead and tin at 20°–150° C. The results for aluminium agree with those obtained with copper and brass, increase of rate of extension being accompanied by a maximum increase of tensile strength of the following amounts (as compared with that of the sample stretched very slowly) at the respective temperatures (° C.): 20°, 11.6%; 105°, 10.8%; 200°, 35.8%; 300°, 110%. At 20°–200° C., the tensile strength of Duralumin was found to be independent of the rate of extension; at 300° and 400° C., increases of 73.3% and 180% in the tensile strength of the alloy were found when the rate of extension was considerably increased. The tensile strengths of lead and tin are markedly dependent on the rate of extension, even at room temperature. The increase of tensile strength due to an increase in the rate of extension is as great as 194% for lead, and 58% for tin, at 150° C. It is suggested that the metals and alloys studied can be safely exposed to sudden stresses, e.g. from water or steam jets without deleterious effect on their tensile properties.—J. S. G. T.

**A Report on Rheological Definitions and Nomenclature Suggested for Discussion.** — (*Rheology Leaflet*, 1937, (1), 4–12).—A complete, logical, and self-consistent system of classification of materials according to their flow characteristics is attempted. The relations involved are all expressed in terms of simple shear strain. Among the definitions of importance to metallurgists which are included are: plasticity, elasticity, strain-hardening, thixotropy, shear strength, and elastic limit in shear.—J. S. G. T.

†**\*Flow Phenomena in Heavily-Stressed Metals.** P. W. Bridgman (*J. Applied Physics*, 1937, 8, (5), 328–336).—Read at a Symposium on Metals held at Cambridge, Mass. The behaviour is studied of thin discs of metal subjected to heavy normal pressures (up to 50,000 kg./cm.<sup>2</sup>) between hardened steel surfaces rotated in opposite directions about an axis normal to the plane of the disc. The curves of shearing stress against mean pressure consist of two essentially different parts; the second involves internal slip of material of the disc on planes parallel to the faces. Shearing strength actually increases by rather large amounts up to pressures of 50,000 kg./cm.<sup>2</sup>. Shearing curves for magnesium, platinum, bismuth, and manganese are given and discussed. The mechanism of slip is discussed. Values of shearing strengths, under 50,000 kg./cm.<sup>2</sup> and at atmospheric pressure, are tabulated for 18 metals. Various metals, subjected to the treatment, emit noises of different characters; the most important is a snapping noise. This occurs less frequently in cubic structures than in others. The conventional method of computing the strengths of materials under usual conditions needs modification; strength must involve consideration of stability and the conditions under which a microscopic rupture can extend if started.—J. S. G. T.

**\*On the Distribution of Internal Shearing Stress in Many Twisted Metallic Rods, and Their Changes Due to Annealing** [Copper, Magnesium, Armco Iron, Steels]. Tarō Ueda (*Kinzoku no Kenkyū (J. Study Metals)*, 1936, 13, (1), 1–17; (2), 61–82; (3), 103–120; (5), 189–212; (6), 269–290).—[In Japanese.] The elastic after-effect (*Nachwirkung*) is studied in Armco iron, carbon steels



containing, respectively, 0.2, 0.4, 0.6, 0.7, 0.9, 1.1, and 1.3% carbon, copper, and magnesium after twisting. In carbon steels, a eutectoid steel containing about 0.9% carbon showed the highest elastic after-effect. The distribution of internal shearing stress in the cross-sections of specimens attaining equilibrium was measured. On the exterior this stress acts so as to tend to advance the twisting deformation; in the interior it acts in the direction of recovery from the initial strain. A large portion of the stress disappeared on annealing the iron and steels at 300°–500° C., the copper at 100°–400° C., and the magnesium at 50°–200° C. The decrease of internal stress by annealing is attributable to recrystallization and grain-growth. Latent energy due to internal stress is about 0.2% of the applied energy in the case of 0.9% carbon steel, 0.12% in 1.3% carbon steel, 0.18% in magnesium, and less for other metals.—J. S. G. T.

**\*Strain and Eigen-Stresses.** E. K. Henriksen (*Ingeniorvidenskabeliger Skrifter*, 1937, A43, 55 pp.).—[In German.] [Note by Abstractor: The German word "eigen" has been absorbed into the language of English mathematics; it signifies intrinsic, specific, characteristic. Eigen-stresses are sometimes termed internal stresses; H. does not approve this nomenclature for eigen-stresses.] There are two principal classes of eigen-stresses, viz. those produced by inequalities of temperature, e.g. those produced in casting, hardening, and welding processes, and those produced by cold-working. The two classes cannot be sharply defined. The presence of eigen-stresses is revealed by microphotography. The theory, and a practical method for determining the values of superficial eigen-stresses from observed strains, are discussed and applied to the case of 3 steels and 1 sample of cast iron strained by being worked on a planing or shaping machine. Compression eigen-stresses apparently arise owing to pressure of the underside of the tool upon the surface of the worked metal; tensile eigen-stresses originate in local heating at the cutting place, accompanied probably by the liberation of single grains of the metal prior to their final separation.—J. S. G. T.

[Discussion on the Paper by O. Föppl on] The Practical Importance of the Damping Capacity of Metals, Especially Steels. — (*J. Iron Steel Inst.*, 1937, 135, 451–460).—Additional discussion on the paper; cf. *Met. Abs.*, 1936, 3, 499, 641.—S. G.

**\*Contribution to the Determination of the Flowing Properties of Liquid Metals.** Wolfram Ruff (*Z. Metallkunde*, 1937, 29, (7), 238–241).—The fluidity of a metal or alloy can be determined by allowing it to flow from a single feed chamber through two horizontal tubes of equal diameter, but different lengths, on to a gauze at a predetermined height below the jets, and measuring the distances between the points at which the two jets strike the gauze and the feet of the perpendiculars. The method is described, with special reference to the measurement of the fluidity of cast iron and steel.—A. R. P.

**\*A Theory of Diffusion in Solids.** John E. Dorn and Oscar E. Harder (*Metals Technology*, 1937, 4, (6); *A.I.M.M.E. Tech. Publ.* 836, 19 pp.).—The process of diffusion is examined theoretically by considering each atom in the crystal lattice to be at the bottom of a potential energy well. The atom is regarded as loosened if its kinetic energy is sufficient to raise it to the top of the well. The effect of foreign atoms in solid solution on the depth of the potential wells is discussed. In a dilute interstitial solid solution, the diffusion of a solute atom involves the loosening of only one atom, whilst in a substitutional solid solution two atomic types must diffuse, and the probability of the simultaneous loosening of two atoms must be considered. Equations for interstitial and substitutional diffusion are derived, and are compared with data for diffusion of different elements in lead, silver, and iron.—W. H.-R.

**Diffusion in Solid Metals.** A Correlated Abstract. A. I. Krynsky (*Metals and Alloys*, 1937, 8, (5), 138–144; (6), 173–179; (9), 261).—A correlated

abstract, reviewing recent literature and providing an excellent summary of the present knowledge of this subject.—A. R. P.

**\*Foreign Inclusions in Metallic Material and Their Detection.** M. Nicssner (*Z. Elektrochem.*, 1937, 43, (8), 546).—Abstract of a paper read before the Deutsche Bunsen Gesellschaft. N. shows, by different examples, how non-ferrous inclusions in iron and steel (oxide, sulphide, silicate, &c.) and in aluminium (oxide, carbide, nitride, &c.) may be detected.—J. H. W.

**\*Vapour Pressure, Thermal Dissociation, and Affinity in Metallurgy.** W. Leitgeb (*Z. Elektrochem.*, 1937, 43, (8), 509–518).—Read before the Deutsche Bunsen Gesellschaft. Illustrates by curves and diagrams the vapour pressure, thermal dissociation, and affinity of a number of metals and metallic systems, and explains how these properties are applied in the separation and refining of metals. A short discussion follows.—J. H. W.

**Thermodynamics and Velocity of Irreversible Processes[—I].** A. R. Ubbelohde (*Trans. Faraday Soc.*, 1937, 33, (5), 599–606).—Mathematical and theoretical. Expressions are derived for correlating the velocity of irreversible processes in a system with its thermodynamic functions. When the kinetic behaviour can be summed up by the average fluctuations in the thermodynamic variables and their time of relaxation, conclusions can be formed of the kinetic behaviour of the system with much less data than when a statistical analysis is attempted. On these premises, Ohm's law, the equation for heat conduction, the Wiedemann–Franz law, and equations for diffusion and viscosity are derived.—A. R. P.

**Thermodynamics and the Velocity of Irreversible Processes. III.—Changes of Structure in Solids.** A. R. Ubbelohde (*Trans. Faraday Soc.*, 1937, 33, (9), 1203–1212).—The thermodynamic theory of spontaneous change is applied to the velocity of irreversible changes in solids. The phenomena of supercooling, superheating, and the law of successive states in the solid–liquid transition are explained in terms of a simple expression for the probability of finding the requisite fluctuations in the system; the phenomenon of hysteresis is discussed in this connection, with special reference to ferromagnetism, formation of  $\beta$ - from  $\alpha$ -palladium hydride, and the order–disorder transformation in alloys. An explanation of supraconductivity is also discussed.—A. R. P.

**\*Controlled Cathode Sputtering.** Gregory Timoshenko (*Nature*, 1937, 140, (3532), 67).—An apparatus is described for measuring the rate of sputtering of metals under controlled conditions. The rates of sputtering from various solid metals are measured under bombardment by argon ions having an energy of 2000–6000 v.—B. C.

**\*Optical Properties of Evaporated Films.** D. H. Andrews, J. A. Sanderson, and E. O. Hulburt (*Phys. Rev.*, 1937, [ii], 51, (11), 1017).—Brief abstract of a paper read before the American Physical Society. In the spectrum region from 0.185 to 10  $\mu$ , the reflectivity and transmission were measured for films of aluminium, antimony, beryllium, boron, chromium, manganese, silicon, and tellurium, prepared by evaporation in vacuum. The reflectivities agreed in the main with previous measurements, so far as these exist. Minima of reflection in the infra-red were noted for antimony, boron, silicon, and tellurium, which appeared to be due to interference, as evidenced by the spacing of the minima and their shift with film thickness.—S. G.

**\*Structure and Resistance of Thin Metal Films.** D. A. Wright (*Nature*, 1937, 140, (3533), 107–108).—It is pointed out that Kramer's theory of the "transition temperature" of thin metal films is supported by the existence of a transition temperature for indium at 10° K., while rubidium and caesium do not behave in accordance with K.'s theory. W. suggests that the transition may be due to the desorption of gas rather than to the crystallization of amorphous metal.—B. C.



\***Oblique Reflection of Light at the Mercury Film Condensed on the Cold Surface of Glass or Tin Leaf.** Tadao Fukuroi (*Sci. Papers Inst. Phys. Chem. Res. Tokyo*, 1937, 32, (719), 157–171).—[In English.] Mercury films of different thicknesses were deposited by vaporization on glass and on tin foil, at the temperature of liquid nitrogen. The effect of film thickness on the intensity and polarization of the partially-polarized light reflected obliquely from the film was studied for cases where the angle between the reflected and incident beams was  $60^\circ$  and  $150^\circ$ , respectively. The results are compared with those calculated from F.'s assumption (*Met. Abs.*, this vol., p. 81) that the brilliant optical phenomena are due to a fine granular, or relief-like, structure of the surface, and are not analogous to Newton fringes formed by interference of light reflected from the upper and lower surfaces of the film.—W. H.-R.

\***On the Light Absorption of Metallic Film[s] at Low Temperature.** [Structure of Metallic Films.] Tadao Fukuroi (*Sci. Papers Inst. Phys. Chem. Res. Tokyo*, 1937, 32, (720), 172–186).—[In English.] Films of mercury, cadmium, and zinc were prepared by evaporation on to a cold quartz surface, and the reflection and transmission of monochromatic light at low (liquid nitrogen) temperatures were investigated experimentally. Curves are given showing the effect of film thickness on the reflection and transmission, and absorption coeffs. for  $\lambda = 560, 465,$  and  $400 \text{ m}\mu$ . The results are compared with those calculated from F.'s theory (see preceding abstract) that the film consists of a number of irregular granules. The interpretation of other effects from the viewpoint of this theory is also discussed.—W. H.-R.

\***On the Photoconducting Effect in Thin Metallic Films.** Tadao Fukuroi (*Sci. Papers Inst. Phys. Chem. Res. Tokyo*, 1937, 32, (721), 187–195).—[In English.] Thin films of mercury, cadmium, and zinc were deposited by evaporation on glass or quartz, at liquid-air temperature and measurements were made of the increase in electrical conductivity when the film was exposed to ultra-violet light. The effect of film thickness was studied. With increasing film thickness the photoconductivity becomes a maximum at a thickness of the order  $10\text{--}20 \text{ m}\mu$ , the exact values being characteristic of the particular metal. The effect is only observed with light of sufficiently short wave-length, and the "photoconductivity thresholds" for mercury and zinc agree well with those of the ordinary photoelectric effect, whilst with cadmium the "photoconductivity threshold" is of about  $20 \text{ m}\mu$  shorter wave-length. The results are considered to support F.'s view (cf. preceding abstracts) that the metallic films consist of small isolated granules from which photoelectrons are emitted.

—W. H.-R.

\***On the "Transformation Temperature" of a Metallic Film.** Tadao Fukuroi (*Sci. Papers Inst. Phys. Chem. Res. Tokyo*, 1937, 32, (722), 196–219). [In English.] Films of zinc, cadmium, mercury, antimony, magnesium, lead, and bismuth were deposited on glass at low temperatures. On gradually increasing the temperature of the film, a critical temperature is reached, at which the electrical resistance diminishes suddenly and irreversibly. For films which are not too thin, the critical temperature decreases with increase in film thickness, and a linear relation exists between the logarithm of the critical temperature (in  $^\circ \text{K.}$ ) and the film thickness. Extrapolating this line to the limit corresponding to zero thickness gives a temperature in the range  $0.36\text{--}0.40$  of the melting point, and corresponding roughly with the recrystallization temperatures of the massive metals. For thick films, the sudden changes are less definite. Experiments on the reflectivity of light, and the sharpness of X-ray diffraction lines, are also described, and show similar irreversible changes. The phenomenon of crack formation is discussed.—W. H.-R.

\***The Second Order Electrical Effects in Metals.** A. H. Wilson (*Proc. Camb. Phil. Soc.*, 1937, 33, (3), 371–379).—The mathematical theory of transport phenomena in metals depends on the solution of a certain integral equation;

the solution of this equation for low temperatures presents difficulties, since, there, a free path cannot be defined. A series solution of the equation up to terms in  $(\theta/T)^2$ , where  $\theta$  is the Debye temperature, is derived by a method of successive approximations. The value of the thermal conductivity of a metal is deduced, and a simple method is given for deriving the ideal electrical conductivity of an impure metal. This matter is discussed in connection with Matthiessen's rule, viz. that the electrical resistance of a metal is the sum of an ideal resistance characteristic of the metal, and a residual resistance due to impurities. An expression is also derived for thermoelectric power.—J. T.

\***Photothermionic Effect in Incandescent Metals.** I. Ranzi and R. Ricamo (*Nuovo cimento*, 1937, [N.S.], 14, (3), 114–118; *Sci. Abs.*, 1937, [A], 40, 988).—When a glowing filament is subjected to white light, the thermionic effect is apparently increased. Vercelli (*Met. Abs.*, 1935, 2, 564) put this down as a photoelectric effect causing a displacement of the threshold value to 4000 Å. Experiments have been carried out using triode valves, joining the grid and plate, and illuminating the filament by passing the light through various filters from a powerful source. The intensity of the light, the plate current, and the resistance of the filament were measured, and the conclusion is reached that for pure tungsten the effect is merely due to heating of the filament, whereas in filaments covered with thorium oxide the photoelectric effect is also present.

—S. G.

\***Effect of Temperature on Photoelectric Emission.** R. J. Cashman (*Phys. Rev.*, 1937, [ii], 52, (5), 512–518).—Existing theories of photoelectric emission near the threshold are critically reviewed. For  $\nu \ll \nu_0$  they lead to an equation of the type  $I = \text{const. } T^n e^{h(\nu - \nu_0)/kT}$ , and at  $\nu = \nu_0$ ,  $I = \text{const. } T^n$ . The value of the factor  $n$  varies from  $\frac{1}{2}$  to  $\frac{5}{2}$ , according to the assumptions of the different theories. Data obtained at the threshold for different temperatures will thus enable the value of  $n$  to be determined. Existing data are reviewed, and show that  $n$  lies between 0.7 and 1.7 for different elements. The apparent departure from the value  $n = 2$  can be explained by assuming that the work-function increases with temperature. A new method is described for determining the temperature coeff. of the work-function, and the results and their applications are discussed.—W. H.-R.

\***A Critical Examination of Benedicks' Homogeneous Electro-Thermal Effect.** William Band (*Proc. Camb. Phil. Soc.*, 1937, 33, (3), 385–389).—B. shows mathematically that the new hypothesis introduced by Benedicks to explain the "electro-thermal" effect in mercury (*Met. Abs.*, 1934, 1, 543), viz. the production of a temperature gradient by a flow of electricity, is quite unnecessary; the complete effect is explicable in terms of the Thomson heat alone. This "electro-thermal" effect cannot be regarded as an inverse of the thermoelectric effect.—J. S. G. T.

\***Diamagnetism of Supraconducting Bodies.** G. C. Wick (*Phys. Rev.*, 1937, [ii], 52, (5), 526).—A discussion of the diamagnetism of supraconducting bodies, and the possibility of a phase for which the induction  $B$  is not zero.

—W. H.-R.

†**Directional Ferromagnetic Properties of Metals.** R. M. Bozorth (*J. Applied Physics*, 1937, 8, (9), 575–588).—Read at a Symposium on the Structure of Metallic Phases. The ways in which the magnetic properties of metals and alloys vary with direction in single crystals, chiefly cubic crystals of iron, nickel, and their alloys are reviewed in considerable detail. A bibliography of 27 references is appended.—J. S. G. T.

**Errata : Magnetic Quadrupole Field and Energy in Cubic and Hexagonal Crystals** (*Phys. Rev.*, 1933, 44, 38), and **Magnetic Interaction and Resultant Anisotropy in Strained Ferromagnetic Crystals** (*Phys. Rev.*, 1937, 52, 18). L. W. McKeehan (*Phys. Rev.*, 1937, [ii], 52, (5), 527).—Numerical mistakes in these papers are indicated and corrected.—W. H.-R.



**On the Nature of Coercive Force and Irreversible Changes in Magnetization.** E. Kondorski (*Physikal. Z. Sowjetunion*, 1937, 11, (6), 597–620).—[In English.] A theory of irreversible changes in magnetization, based on the displacement of boundaries between regions of spontaneous magnetization, differing somewhat from Bloch's theory, is developed. Theoretical values of remanence agree well with experimental values in the case of a nickel-iron alloy (15% nickel, 85% iron). Measurements of the reversible susceptibility, remanence, and coercive force under various tensions up to 83 kg./mm.<sup>2</sup> are discussed.—J. T.

**\*On the Electron Theory of Metals.** Kanetaka Ariyama (*Sci. Papers Inst. Phys. Chem. Res. Tokyo*, 1937, 32, (714), 103–119).—[In German.] Theoretical. The theory of Schlubin and Wonsowsky (*Met. Abs.*, 1936, 3, 113, 645) is developed, with special reference to ferromagnetism.—W. H.-R.

**\*Application of Hahn's Emanation Method to Metal Problems.** (Seith and K pferle.) See p. 506.

†**Physical Constants of the Elements.** — (*Metals Handbook (Amer. Soc. Metals)*, 1936, 14–17).—Compiled by a sub-committee of the American Society for Metals, the data have been checked by about 50 specialists. Values are given for atomic weight, density (gm./cm.<sup>3</sup> at 20° C.; lb./in.<sup>3</sup> at 68° F.); atomic volume, melting point, boiling point, specific heat, latent heat of fusion (cal./gm.; B.t.u./lb.); linear coeff. of thermal expansion (° C. and ° F. at room temperature), thermal conductivity, electrical resistivity, modulus of elasticity (tension), type of crystal lattice, lattice constant, closest approach of atoms (A).—S. G.

## II.—PROPERTIES OF ALLOYS

(Continued from pp. 430–437.)

**\*The Thermal and Electrical Conductivity of Cast Aluminium Alloys with Special Reference to the Self-Improving Alloys.** Max Elfloin (*Forschungsarbeiten  ber Metallkunde u. R ntgenmetallographie*, 1937, (23), 63).—Apparatus for the measurement of thermal conductivity at about 18°–150° C., and for the measurement of electrical conductivity at 20° and 100° C. is described, and results obtained therewith relating to 53 samples of cast aluminium alloys, principally of the self-improving type, are tabulated. In addition, values of the sp. gr., Rockwell hardness, and Lorentz "constant" of some of the alloys are tabulated.—J. S. G. T.

†**Constitution of the Iron-Aluminium Alloys.** T. D. Yensen and F. R. Hensel (*Metals Handbook (Amer. Soc. Metals)*, 1936, 248–250).—A critical discussion of the literature, with a *bibliography* of 30 references. An equilibrium diagram is given, based on the data of Gwyer, Dix, Hanson, Kurnakow, Murakami, Iwas , Wever, and Osawa.—S. G.

**\*On the Change in Tensile Properties and Corrosion-Resistance of the Aluminium-Copper-Magnesium Alloy DM 31 by Cold-Deformation.** Karl Bungardt (*Z. Metallkunde*, 1937, 29, (7), 234–235).—The endurance limit under alternate bending stresses of aluminium alloy DM 31 is practically unaffected by cold-rolling or drawing into wire, and the percentage reductions in tensile strength and elongation during corrosion tests in the DVL machine show no definite relation to the degree of reduction in cold-work. Minimum values for the endurance limit, and decrease in tensile properties, are shown, however, by metal which has been reduced by about 5% either by rolling or drawing; the cause of this phenomenon has not been ascertained.—A. R. P.

**\*The Age-Hardening and Properties of Aluminium-Magnesium Alloys.** D. A. Petrov (*Tehnika Vosdushnogo Flota (Tech. Air Fleet)*, 1937, (1), 63–77).—[In Russian.] The influence of small amounts of beryllium (0.6 and 1%), chromium (0.8 and 0.4%), copper (2.0%), and lithium (1.0%) was studied. Silicon and manganese increase the tensile strength and decrease the

elongation of aluminium-magnesium alloys. The mechanical properties of aluminium-magnesium alloys are improved by additions of beryllium and chromium, but additions of lithium are of no advantage, and the same applies to copper when the magnesium content exceeds 4%. The results are illustrated by graphs and tables, and a detailed review is given of the literature.—N. A.

\*On the Refining of Silumin by the Alkali Metals. J. Czochralski and J. Kaczyński (*Wiadomości Instytutu Metalurgii i Metaloznawstwa (Warszawa)*, 1937, 4, (1), 18-25).—[In Polish, with French summary.] The influence of small additions of the alkali metals lithium and potassium, and of the fluorides of rubidium and caesium, on the refining of Silumin containing 13% silicon, 0.1% iron, traces of calcium and the remainder aluminium, were determined by metallographic analysis and mechanical testing of sand-cast samples of the product of refinement. All the alkali metals influence the structure and mechanical properties of Silumin, but their action depends on their physical and chemical properties, such as melting and boiling points, or the ability to form definite compounds with the constituents of Silumin. It has been shown that potassium acts in a manner similar to sodium, the total effect being obtained by the addition of 0.6% of the metal which gives a product containing 0.01%. Lithium, however, acts in a manner similar to calcium, and unlike sodium and potassium. The maximum tensile strength and elongation, and the best structure, were obtained by adding 0.55% of lithium, which gave a product containing 0.14% of the metal. Rubidium and caesium added as fluorides in 2% quantity at 700° C. gave only incomplete results, so that it is to be expected that an increase in the quantity added would cause complete modification.—P. W. R.

**Cetal: A New Aluminium-Silicon Alloy.** — (*Giesserei-Praxis*, 1937, 58, (21/22), 209-210).—Describes the properties and method of production of Cetal, an aluminium alloy containing silicon 6.5, zinc 10, and copper 3%. Small amounts of magnesium and iron and manganese are also frequently added to improve the mechanical properties.—J. H. W.

**Beryllium and Its Alloys.** R. Gadeau (*Rev. gén. Élect.*, 1937, 42, (11), 328-334).—A review of the properties of beryllium and its alloys, with particular reference to the characteristics, working properties, and applications of the age-hardening copper-beryllium alloys.—J. C. C.

**Precipitation-Hardening of Alloys of Beryllium With Copper and Nickel.** — (*Metallurgist (Suppt. to Engineer)*, 1937, 11, 29-30).—A review of recent work on the subject, which indicates that the microscopically non-homogeneous precipitation process plays a minor part in the hardening since it occurs after most of the new phase has precipitated.—R. G.

**Fusible Alloys.** Kent R. Van Horn (*Metals Handbook (Amer. Soc. Metals)*, 1936, 884-887).—The characteristics and uses of the fusible alloys are briefly discussed. A table gives the melting points of numerous compositions.—S. G.

**The Use of Indium in Fusible Alloys.** Sidney J. French (*Met. Ind. (N.Y.)*, 1937, 35, (3), 106-107).—Addition of 18% of indium to Lipowitz's alloy reduces the melting point to 47° C.; this alloy can be used in surgical work since the molten alloy produces no discomfort to the skin. Another use is for fire sprinklers. (See also French, *Met. Abs.*, 1936, 3, 74, 148, 297; and French and Saunders, *Met. Abs.*, 1936, 3, 148, for other work on the Lipowitz alloys.)  
—A. R. P.

**Fusible Alloys Containing Tin.** E. J. Daniels (*Tech. Publ. Internat. Tin Res. Develop. Council, Series B*, 1937, (5), 24 pp.).—The compositions, properties and uses of tin alloys melting below about 450° C., excluding tin-lead mixtures, are reviewed. Matters discussed include: the relation between composition and melting point; microstructure, creep, ageing, castability, casting contraction, safety appliances employing fusible alloys, solders and seals, moulding and electroplating, tube bending, tempering baths, matrix



alloy, research uses and metallized wood. A bibliography of 117 references is appended.—J. S. G. T.

**Cadmium-Nickel NS 5 Bearing Metal.** H. L. Evans and S. T. Harrison (*Tech. Bull. Imperial Smelting Corpn.*, 1937, (May), 26 pp.).—The alloy "Cadmium-Nickel NS 5," known in America as Asarecoloy, contains nickel 1.3%, and has a structure of hard particles of NiCd, in a softer eutectic matrix of almost identical density. Details of the mechanical properties of the alloy are given, and the method of lining bearings with it is described. Steel, to which it bonds firmly, is recommended as a material for the shells.—J. C. C.

†**Constitution of Iron-Chromium Alloys.** Edgar C. Bain and Robert H. Aborn (*Metals Handbook (Amer. Soc. Metals)*, 1936, 259-261).—A critical discussion of the literature, with a bibliography of 18 references. An equilibrium diagram is given, based on the data of various investigators.—S. G.

**The Mechanical Properties of Heat-Resistant Chromium-Aluminium-Iron Alloys in Comparison with Nichrome Alloys.** W. Hessenbruch (*Elektrowärme*, 1937, 7, (1), 7-12).—The properties of iron alloys with chromium 20-30 and aluminium 5% are compared with those of 60 : 18.5 : 21.5 nickel-chromium-iron and 80 : 20 nickel-chromium alloys in a series of graphs. Methods of casting, working, and heat-treating the iron-base alloys are also described.—A. R. P.

\***Recrystallization Diagram of Aluminium Bronze Containing 2 Per Cent. and 5 Per Cent. Aluminium.** J. Czochralski and N. Lewicka (*Wiadomości Instytutu Metalurgii i Metaloznawstwa*, 1937, 4, (2), 61-63).—[In Polish, with German summary.] The recrystallization process in aluminium bronzes containing, respectively, 1.86 and 5.28% aluminium is found to be the same as that characterizing the pure metals. Compared with the recrystallization of copper, the grains in the alloys are larger, more especially in the 5.28% aluminium bronze. This difference of grain-size increases with increase of annealing temperature (up to 1000° C., the highest investigated).—J. S. G. T.

**A Forgotten 4000-Year Old Alloy of Copper and Arsenic.** Wilhelm Witter (*Tech. Blätter*, 1937, 27, 91; *Chem.-Zeit.*, 1937, 61, 149; *C. Abs.*, 1937, 31, 7021).—Eleven dagger blades found in Germany had a high arsenic content, resembling, in this respect, ancient Peruvian and Egyptian copper alloys. Since arsenic was not known 4000 years ago, arsenic-containing ores must have been used. It is proposed to manufacture similar copper-arsenic alloys instead of tin alloys, because Germany has to import tin.—S. G.

**Cupro-Berylliums: Their Significance and Future, in Particular in the Copper Foundry.** J. Laissus and L. Persoz (*Congrès Internat. Fonderie, Paris, (Preprint)*, 1937, 12 pp. (in French); also *Cuivre et Bronze*, 1937, 10, (88), 7, 9, 11, 13, 15, 17; and *Found. Trade J.*, 1937, 57, (1103), 279-281; (1104), 300-301).—The constitution of the copper-beryllium alloys, and the mechanism of their precipitation-hardening properties, are explained. Melting practice (with emphasis on the necessity for complete deoxidation of the copper before the addition of the beryllium hardener) and thermal treatment are described, and a survey is given of available information on the physical and mechanical properties of the alloys. The effects of adding cobalt to the alloys are explained, and applications of both cast and wrought alloys are described.—H. H.

**New Copper Alloys, Age-Hardened, Have High Conductivity [Trodaloy No. 1 and No. 2].** T. S. Fuller (*Metal Progress*, 1937, 32, (1), 51-52).—An account is given of Trodaloy No. 1 and No. 2, two copper-beryllium alloys containing, respectively, cobalt and chromium in addition to the principal ingredients. In both cases the electrical conductivity of the cast material is markedly increased when the alloy is quenched and reheated. Suitable temperatures are indicated in each case, and the mechanical properties of both alloys are given for various conditions of temperature and working.—P. R.

\***The Catalytic Union of Hydrogen and Oxygen on Copper and Copper-Gold Alloys.** (van Cleave and Rideal.) See p. 482.

†**Constitution of Iron-Copper Alloys.** J. L. Gregg and B. N. Daniloff (*Metals Handbook (Amer. Soc. Metals)*, 1936, 262-264).—A critical review of the literature, with a *bibliography* of 16 references. An equilibrium diagram is given, based on the data of various investigators.—S. G.

\***Construction and Properties of the Manganin Resistance Pressure Gauge.** L. H. Adams, R. W. Goranson, and R. E. Gibson (*Rev. Sci. Instruments*, 1937, [N.S.], 8, (7), 230-235).—The variation with pressure of the electrical resistance of a coil of wire is known to depend on the size and construction of the coil, as well as on the composition of the wire. The linearity of the pressure-resistance relation also depends on the size and type of coil. The effects of winding, heat-treatment, and pressure seasoning on the resistance and pressure coeff. of various coils of Manganin were determined, and measurements were made of the effect of temperature (between 0° and 70° C.) on the pressure coeff. of resistance of Manganin. It is found that  $\Delta R/R_0 P$  increases by about  $0.18 \times 10^{-3}$  of its value for each degree of increase of temperature.—J. S. G. T.

**On Segregation Phenomena in Lead-Bronzes.** W. Claus (*Congrès Internat. Fonderie, Paris, (Preprint)*, 1937, 4 pp.; and *Cuivre et Bronze*, 1937, 10, (86), 13, 15, 17).—[In French.] The copper-lead, copper-lead-nickel, and copper-lead-tin systems are discussed, with respect to the effects of the miscibility gap, which are not thought to be important in normal foundry practice. Inverse segregation is considered much more serious, and is attributed to dissolved gas, mainly hydrogen, in the bronze. The effects of cooling rate are described.

—H. W. G. H.

\***The Liquefaction Process in the Solidification of Copper-Lead and Copper-Lead-X Alloys.** (Lead Bronzes with Two or More Constituents.) W. Claus (*Z. Elektrochem.*, 1937, 43, (8), 502-503).—Read before the Deutsche Bunsen Gesellschaft. The binary alloys of copper and lead show a miscibility gap in the liquid state between 37 and 93% lead. In the gap, a layer formation occurs in the liquid state after the appearance of the second phase. Hence, considerable difficulties may arise in the technical application of alloys in this range, and these difficulties are outlined. The same applies to the copper-lead bronzes of three or more constituents; but another kind of liquation plays a definite part in the technical production of these alloys, namely so-called inverse segregation. The explanation of the displacement of the residual melt from the centre of the casting to the outside lies in the liberation of gas (hydrogen) that occurs during the process of solidification. The analysis of a hollow cylindrical casting of a quaternary alloy containing copper 73.5, lead 15, tin 10, and nickel 1.5% showed that the outer layer contained lead 91.7, tin 5.1, copper 1.4, and nickel 1.8%, and the inner layer: copper 79.2, tin 10.6, lead 8.9, and nickel 1.3%. The mechanism of inverse segregation is of a thermal nature.—J. H. W.

**How to Combat Failures of Lead-Bronze.** V. S. Rjeznikov (*Aviopromishlennost (Aeroplane Ind.)*, 1937, (1), 15-18).—[In Russian.] A short review.

—N. A.

\***Contribution to the Technology and Metallurgy of Bearing Metals.** F. Bollenrath, W. Bungardt, and E. Schmidt (*Luftfahrtforschung*, 1937, 14, (8), 417-425).—The properties of leaded bronzes, lead-base bearing metals, copper-lead alloys containing small amounts of tin, iron, nickel, antimony, phosphorus, or sulphur, magnesium-copper-cadmium, and silver-copper-cadmium bearing alloys are shown in tables and graphs. The effects of induction melting of lead-copper alloys, and of the presence of small amounts of various impurities in them, on the distribution of the lead were investigated. In alloys made from pure copper and pure lead melted in a high-frequency furnace, the lead remains homogeneously distributed as a fine emulsion in the casting, even when the alloy contains as much as 46% lead. Addition of up to 0.5% tin has little effect on the lead distribution, but 1% produces considerable segregation,



which is also produced by 0.1% arsenic, 0.2% antimony, 0.1% zirconium, and less than 0.1% sulphur or phosphorus. Small amounts of nickel or manganese have relatively little effect.—A. R. P.

**The Effect of Manganese on the Annealing-Brittleness of Cupro-Nickel.** C. Blazey (*Monthly J. Inst. Metals*, 1937, 4, (8), 442).—Correspondence on a paper by Bose (*J. Inst. Metals*, 1937, 60, 133). Specimens containing no manganese became much more brittle on annealing than any containing normal quantities. The embrittlement of cold-rolled strip (0.041% carbon, 0.118% manganese) coincided with graphite precipitation, being a function of total carbon content, time and temperature of annealing, and another factor attributed to impurities other than carbon. Failure at all annealing temperatures occurred at a graphite content of 0.005%, further precipitation leading to no improvement in ductility.—G. V. R.

**\*Mechanical Properties of Some Tin Bronzes.** H. Lepp (*Tech. Publ. Internat. Tin Res. Develop. Council, Series D*, 1937, (3), 11 pp.; and *Found. Trade J.*, 1937, 57, (1105), 321–322, 328).—The metallography of the system copper-tin is briefly reviewed. Most investigators agree that the solid solubility of tin in copper extends to at least 13% tin; L. has shown that this limit can be extended to 14% tin, and that it can be realized industrially if the alloys are sufficiently degasified. The mechanical properties of the bronzes can be improved very considerably by suitable degasification. The tensile strength, % elongation, and Brinell hardness of 5 bronzes containing 85–90% copper are tabulated. The maximum hardness is found in the 87 : 13 copper-tin alloy, and the minimum in the alloy of 85% copper with 5% each of tin, zinc, and lead. Bronzes containing up to 14% tin become perfectly malleable, both hot and cold, after suitable degasification. Increasing the phosphorus content increases the breaking load and the elastic limit of bronzes containing 10–14% tin; the reduction in area on extension is about 75–87% for these alloys, and can reach 97% for short test-pieces. The impact value of the annealed bronzes is 12.5–13.8 kg./cm.<sup>2</sup>. In the case of bronzes containing 6.5–14% tin, with increasing tin content, cold-working hardens the alloy to an increased extent, and bars containing 14% tin may have a tensile strength > 100 kg./mm.<sup>2</sup>, and an elongation of 3–4%. All these bronzes containing up to 14% tin consist of a solid solution of tin in copper; with 14.5% tin, the  $\delta$  constituent appears.—J. S. G. T.

**\*Mechanical Properties of Four Binary Tin Bronzes at Room and Elevated Temperatures.**—I–II. Claus G. Goetzel (*Metals and Alloys*, 1937, 8, (8), 231–234; (9), 245–249).—The variations in the elastic limit, yield-point, tensile strength ( $\sigma$ ), elongation, reduction in area, Brinell hardness ( $H_B$ ), modulus of elasticity, and  $\sigma/H_B$  ratio brought about by increase in temperature are shown in a series of graphs. Characteristic microstructures after various heat and mechanical treatments are illustrated.—A. R. P.

**\*X-Ray Investigations on the Tin-Bronzes.**—II. Takesaburo Isawa (*Mem. Ryojun Coll. Eng.*, 1937, 10, (4), 53–61).—[In German.] See abstract from publication in Japanese, *Met. Abs.*, this vol., p. 37.—S. G.

**\*Effect of Tellurium on Mechanical Properties of Certain Copper-Base Alloys.** H. L. Burghoff and D. E. Lawson (*Metals Technology*, 1937, 4, (6); and *A.I.M.M.E. Tech. Publ.*, 844, 10 pp.).—The effects of small (up to 1%) additions of tellurium on the mechanical properties of drawn rods of the following copper-base alloys were investigated: commercial brass (10% zinc), tin bronze (1.5% tin), and silicon bronze (silicon 3, zinc 1, and copper 96%). The relative machine abilities were taken to be inversely proportional to the number of strokes of a power-driven hacksaw necessary to sever bars of the same diameter. Bending and hardness tests were also carried out. In all cases the machinability was increased by the addition of tellurium. Hard-

ness and strength were little affected, whilst the toughness and ductility were decreased.—W. H. R.

\*Contributions to the System Study of Affinity. LXXI.—On the Heat of Formation in the Copper-Zinc System. Friedrich Weibke (*Z. anorg. Chem.*, 1937, 232, (3), 289-296).—The heats of formation of alloys of copper with up to 63.1 atomic-% of zinc were determined from the electrochemical measurements of A. Ölander and the measurement of the heat of formation of saturated  $\alpha$ -brass (2.35 kg.-cal./grm.-atom).—A. R. P.

Influence of the Degree of Reduction on the Properties of Cold-Rolled Brass Sheet (Ms 63). F. Ostermann (*Kalt-Walz-Welt* (Suppt. to *Draht-Welt*), 1937, (8), 53-55).—Brass sheet containing 62% copper (the lower limit for the German standard product Ms 63) is liable to separation of the  $\beta$ -constituent under certain conditions of working and annealing, whilst the properties of the material are noticeably influenced by the grain-size. The tensile properties, Brinell hardness, and Erichsen value of brass sheet 0.5 mm. thick are tabulated for various reduction factors, the corresponding commercial degree of hardness ("hard," "quarter-hard," &c.) being indicated. Suitable annealing temperatures, corresponding to various reduction factors, are also tabulated.

—P. R.

Special Brasses. C. H. S. Tupholme (*Canad. Chem. & Met.*, 1937, 21, (5), 190, 192).—Ordinary free-cutting yellow brass contains copper 50-60, lead 1.75-3.0, maximum impurities 0.7%, and zinc the remainder; a good quality brass of this type has a tensile strength of 20 tons/in.<sup>2</sup>, with an elongation of 20% or more. Brass for stamping, with a tensile strength of 25 tons/in.<sup>2</sup> and an elongation of 25%, contains copper 58, zinc 40.5 and lead 1.5%. Hardenable brass contains about 72% copper and 20% zinc with 8% of nickel and aluminium in the ratio 4 : 1; this alloy has a tensile strength of 23 tons/in.<sup>2</sup>, a proof stress of 5 tons/in.<sup>2</sup>, and an elongation of 60% when quenched from 850° C., the corresponding values after reheating at 500° C. being 36, 22, and 30. If the quenched alloy is cold-rolled prior to reheating, these values become 48, 45, and 10, respectively.—A. R. P.

\*Contributions on Metals and Alloys. XX.—X-Ray Analysis of Gallium Bronzes. E. Zintl and O. Treusch (*Z. physikal. Chem.*, 1936, [B], 34, (3/4), 225-237).—The results obtained indicate the existence of only 3 intermediate phases stable at room temperature, and a maximum solid solubility of gallium in copper of 15 atomic-% at 20° C. Within the range 20-24 atomic-% gallium, the  $\alpha$ -,  $\mu$ - and  $\delta$ -phases are always found together. The  $\mu$ -phase is close-packed hexagonal, with  $a = 2.594$ ,  $c = 4.229$  A., and the  $\delta$ -phase is of the  $\gamma$ -brass type, with  $a = 8.711$  A., 13 atoms per unit cell, corresponding to  $\text{Cu}_3\text{Ga}_4$ . The  $\phi$ -phase has a narrow range of homogeneity around 58 atomic-% gallium; examination of a single crystal showed the structure to be tetragonal,  $a = 2.830$ ,  $c = 5.831$  A.,  $d = 7.24$ , 3 atoms per unit cell. Since there is ordered distribution of the atoms among the lattice points, it is suggested that this phase is  $\text{CuGa}_2$ , stabilized by the formation of solid solutions with excess copper. The crystals exhibit good cleavage perpendicular to the principal tetragonal axis.—A. R. P.

Nickel in Lead-Base Bearing Metals. — (*Nickel Bull.*, 1937, 10, (8/9), 174-176).—Discusses the influence of added elements to bearing metals, particularly of nickel and arsenic. Up to 2% nickel results in superior compressive strength and hardness, without loss of plasticity in the lead-rich matrix, and also ensures the retention of the desired hardness at operating temperatures. Even with temporarily inadequate lubrication, the nickel alloy retains its hardness under conditions of fluctuating temperatures. The properties of a bearing alloy containing lead 72-78.5, antimony 14-16, tin 5-7, copper 0.8-1.2, nickel 0.7-1.5, arsenic 0.3-0.8, and cadmium 0.7-1.5% are described.—J. H. W.



Transformations in the Ternary System Sulphur-Lead-Oxygen. G. G. Urazov (*Metallurg (Metallurgist)*, 1935, 10, (3), 27-37).—[In Russian.] A discussion.—S. G.

\*Magnesium Alloys. C. H. Desch (*J. Roy. Aeronaut. Soc.*, 1937, 41, (317), 369-381; discussion, 381-387; also *Met. Ind. (Lond.)*, 1937, 50, (5), 161-167; *Metallurgia*, 1937, 15, (87), 89-92; *Metal Progress*, 1937, 31, (3), 300-302, 304).—The properties of magnesium are discussed in relation to its applications. Details of magnesium-rich casting alloys are given, and typical castings used in aircraft are illustrated. Special attention is paid to the subject of working magnesium alloys by rolling, forging, and pressing. Particulars are given of high-strength wrought magnesium-rich alloys containing aluminium 7.5 to 8.5, silver 2.5 to 3, and manganese about 0.4%, recently developed at the National Physical Laboratory. These alloys, in the form of 1-in. forged bars, suitably heat-treated, gave values for tensile strength, proof stress (0.1%), and elongation of (about) 25 tons/in.<sup>2</sup>, 16.5 tons/in.<sup>2</sup>, and 3.5 to 6%, respectively; larger forgings gave somewhat lower strength values. Another alloy containing (approx.) cerium 10, cobalt 1.5, manganese 1.5% has been developed for service at increased temperatures, and has given promising results as a material for pistons. The corrosion-resistance of magnesium alloys is discussed in relation to attack by leaded fuels, and the use of the alloys as material for airscrews.—H. S.

\*Influence of a Third Component on the Properties of Magnesium-Aluminium Alloys. J. A. Amsterdamski (*Legkie Metalli (Light Metals)*, 1936, (11), 45-56).—[In Russian.] Addition of 0.3-0.4% manganese, nickel, silicon, bismuth, and antimony, and up to 2.5% cadmium to magnesium alloys with 7-10% aluminium was studied. None of these metals changed in any way the process of disintegration of the supersaturated  $\delta$ -solid solution, which remained the same as for the binary magnesium-aluminium alloys, and consisted of a coarsely dispersed separation of the  $\gamma$ -component (see *Met. Abs.*, 1935, 2, 577). The disintegration is microscopically revealed at the outset of the ageing of the alloy during normalizing. With further ageing the  $\gamma$ -phase separation spreads from the grain boundaries inwards. The mechanical properties of the binary alloys are not altered materially by additions of the third components enumerated in the quantities mentioned.—D. N. S.

\*On the Mechanical Properties and Corrosion-Resistance of Magnesium-Manganese Alloys. Hideo Mikashima (*Kyushu Teikoku-Daigaku Kokaku Iho (Tech. Rep. Kyushu Imp. Univ.)*, 1937, 12, (3), 123-144).—[In Japanese.] See also *Met. Abs.*, this vol., p. 331.—S. G.

\*Some Studies on Iron-Manganese and Iron-Manganese-X Alloys Containing Extra Low Carbon. Siro Isida (*Tetsu to Hagane (J. Iron Steel Inst. Japan)*, 1937, 23, (8), 799-806).—[In Japanese.] For this investigation, ferro-manganese containing extra low carbon (carbon 0.22, manganese 80-50, silicon 1.49%) was prepared. By mixing the ferro-manganese and Armco iron, the samples were produced in a high-frequency induction furnace, special precautions being taken against carburization. The compositions of the samples were determined by chemical analysis, and the carbon contents were always kept below 0.06%. The Ar and Ac transformations were determined by the method of thermal dilatation. The mechanical properties of the forged samples were determined in the annealed, quenched, and tempered after quenching conditions. The hardening of the alloys is discussed. It is found that the machinability of iron-manganese alloys is dependent on the carbon content.—S. G.

\*Alloys of Iron Research. XII.—Note on the  $\beta_M$  Transformation in Manganese-Rich Iron-Manganese Alloys. Marie L. V. Gayler and C. Wainwright (*J. Iron Steel Inst.*, 1937, 135, 269-273; discussion, 274-280).—See *Met. Abs.*, this vol., p. 184.—S. G.

†**Constitution of Iron-Manganese Alloys.** V. N. Krivobok and Cyril Wells (*Metals Handbook (Amer. Soc. Metals)*, 1936, 265-268).—A critical discussion of the literature, with a *bibliography* of 47 references. An equilibrium diagram is given, based partly on the work of Gayler, and partly on that of Walter and Wells.—S. G.

†**Iron-Manganese-Carbon Alloys.** C. Wells (*Metals Handbook (Amer. Soc. Metals)*, 1936, 290-296).—A critical discussion of the literature, with a *bibliography* of 13 references. A diagrammatic representation, and various sections of the diagram are given.—S. G.

\***The Magnetic Susceptibility of Copper Amalgam.** H. S. Venkataramiah (*Proc. Indian Acad. Sci.*, 1937, [A], 5, (6), 532-534).—The magnetic susceptibility of pure mercury was found to be  $-0.170$ ; this is lower than the value  $-0.19$  given in International Critical Tables, but agrees with that ( $-0.168$ ) recently found by Bates and Tai, and by Vogt. The susceptibilities of 9 copper amalgams containing from 0 to 2.92% copper by weight are tabulated; the values decrease steadily from  $-0.170$  for pure mercury to  $-0.1674$  for the 2.92% copper amalgam. The diamagnetism of the amalgams is less than that deduced from the additive law.—J. S. G. T.

\***The Magnetic Properties of Iron Amalgams.** L. F. Bates and P. F. Illsley (*Proc. Phys. Soc.*, 1937, 49, (5), 611-618).—Values of the saturation magnetization and the paramagnetic susceptibility of iron amalgams were determined at  $-78.5^{\circ}\text{C}$ . Only very minute quantities of iron can be absorbed by mercury before ferromagnetic properties are evident in the amalgams. The iron behaves as if its specific magnetization were 130 c.g.s. units in place of the 220 normally exhibited by pure iron in bulk at  $-78.5^{\circ}\text{C}$ . With increasing iron-content, the paramagnetism of the amalgam increases; it is suggested that combination of iron and mercury is responsible for this effect.—J. S. G. T.

**The Economic Value of Amalgam in Operative Dentistry and the Technic of Its Use.** George M. Hollenback (*J. Amer. Dental Assoc.*, 1937, 24, (8), 1318-1326).—The preparation of tooth cavities, and correct methods of filling them with amalgam, are described, with reference to diagrams. The preparation and properties of amalgam are also discussed.—A. R. P.

**Physical Properties of Filling Materials.** George M. Hollenback (*J. Amer. Dental Assoc.*, 1937, 24, (7), 1080-1089).—The use of gold foil, gold inlay, and amalgam in the filling of teeth cavities is discussed, with reference to the physical properties of these filling materials.—A. R. P.

**Alloy  $p_H$ .** Orman Whitman (*J. Amer. Dental Assoc.*, 1937, 24, (6), 955-956).—Better packing of the amalgam in the tooth, and better and more complete removal of the excess mercury is obtained if, after triturating the alloy with the mercury, the amalgam is moistened with 2-3 drops of 0.25-0.5% sulphonic acid in the hand before packing in the tooth.—A. R. P.

\***Catalytic Decomposition of Sodium Amalgam.**—I. A. S. Fokin and M. A. Rabinovich (*Ukrainski Khimichni Zhurnal (J. Chim. Ukraine)*, 1933, 8, 355-365; *C. Abs.*, 1935, 29, 2062).—[In Ukrainian.] Decomposition of sodium amalgam by aqueous sodium hydroxide is catalyzed by reduced iron, vanadium, tungsten, nickel, and manganese, and by alloys of iron with vanadium, tungsten, silicon, molybdenum, titanium, zirconium, and boron, as well as by salts of vanadium and tungsten. Cast iron has only a feeble action.

—S. G.

†**Constitution of Iron-Molybdenum Alloys.** W. P. Sykes (*Metals Handbook (Amer. Soc. Metals)*, 1936, 269-270).—A critical review of the literature, with a *bibliography* of 4 references. An equilibrium diagram is given based on the data of Sykes, Takei and Murakami, and Arnfelt.—S. G.

\***Measurements of the Torsion Modulus of Nickel-Copper Alloys.** Rimpei Rikuchi (*Kinzoku no Kenkyu (J. Study Metals)*, 1936, 13, (1), 41-43).—[In Japanese.] Measurements of the torsion modulus of the series of nickel-



copper alloys indicate that the alloy containing about 60% nickel is anomalous as regards its value of this modulus.—J. S. G. T.

\*Some Alloys for Use at High Temperatures. IV.—The Constitutions of the Alloys of [Nickel and Chromium, Nickel and Iron, and] Nickel, Chromium, and Iron. C. H. M. Jenkins, E. H. Bucknall, C. R. Austin, and G. A. Mellor (*Iron Steel Inst., Advance Copy, 1937, (Sept.), 34 pp.*).—(A.—) The constitution of the chromium-iron alloys is discussed briefly. (B.—) Previous work on the system iron-nickel is discussed. The solidus curve was redetermined experimentally. In agreement with the work of Kasé (*J. Inst. Metals, 1927, 38, 414*), the solidus passes through a minimum below that of the liquidus, although theoretical considerations require the solidus and liquidus to meet at the temperature which is the minimum in the diagrams. (C.—) The equilibrium diagram of the system nickel-chromium was determined, by thermal and microscopic methods, in the range 0-90% chromium at temperatures above 800° C. The diagram is of the simple eutectiferous type, with primary solid solutions in each metal, the eutectic point being at 1345° C., and approx. 51% chromium. The maximum solubility of chromium in nickel is 47% at the eutectic temperature, and diminishes almost linearly with temperature to slightly less than 40% at 800° C. The duplex field at the eutectic temperature extends from 47 to 65% chromium, but below the eutectic temperature, the solubility of nickel in chromium diminishes rapidly with decreasing temperature. (D.—) The constitution of the ternary system nickel-iron-chromium above 800° C. was determined by thermal and microscopic methods, and the results are illustrated by horizontal sections of the phase diagram.—W. H.-R.

†Constitution of Iron-Nickel Alloys. Paul D. Merica (*Metals Handbook (Amer. Soc. Metals), 1936, 271-273*).—A critical discussion of the literature, with a bibliography of 35 references. An equilibrium diagram is given, based on the data of numerous investigators, but chiefly on the work of Hanson and Hanson (transformations), Hanson and Freeman (liquidus and  $\delta$  region), and Honda and Miura (irreversible transformations).—S. G.

†The Iron-Nickel-Chromium System. Edgar C. Bain and Robert H. Aborn (*Metals Handbook (Amer. Soc. Metals), 1936, 297-301*).—A critical review of the literature, with a bibliography of 8 references. Various sections of the diagram are given, on a small scale.—S. G.

Heat-Resistant Alloys. Causes of Deterioration. The Iron-Chromium-Nickel Alloys. M. Ballay (*Bull. soc. roy. belg. ing. ind., 1937, 203-245*).—A review, with numerous references.—S. G.

[Nivarox] A New Annealable Alloy with a Small Temperature Coefficient of the Elastic Modulus. R. Straumann (*Helv. Phys. Acta, 1937, 10, (4), 269-270; C. Abs., 1937, 31, 7020*).—[In German.] The disadvantages of Elinvar, of strong damping and high sensitivity to magnetic fields, are overcome in a new alloy, Nivarox, by replacing the hardening component carbon in Elinvar by beryllium and small additions of chromium, molybdenum, tungsten, titanium, silicon, and manganese. This is specially important for springs of watches, as they are not affected by magnetic fields.—S. G.

\*Study of Magnetic Losses at Low Flux Densities in 35 Permalloy Sheet. W. B. Ellwood and V. E. Legg (*J. Applied Physics, 1937, 8, (5), 351-358*).—The phenomenon termed "residual," "magnetic viscosity," or "square law hysteresis" loss occurring at comparatively low flux densities in 35 Permalloy sheet is investigated. The results suggest that surface layers of low permeability are present on the sheet material.—J. S. G. T.

\*Low Flux Density A.C. Losses in "35" Permalloy Sheet. V. E. Legg (*Phys. Rev., 1937, [ii], 51, (11), 1009*).—Brief abstract of a paper read before the American Physical Society. In making precise a.c. bridge measurements on a coil wound on a laminated 35 Permalloy core, both the resistance and inductance are found to vary with frequency in a manner not predicted by classical

theory. From the resistance measurements, the losses are separated in the usual way into hysteresis, eddy current, and residual components. The hysteresis loss per cycle is found to be independent of frequency, and to agree with that obtained by ballistic galvanometer measurements (see Ellwood and Legg, preceding abstract). The eddy current loss coeff. observed in the range 500  $\sim$  to 10,000  $\sim$  is approx. 20% greater than computed from classical theory, and it appears to increase as the frequency decreases. The residual loss coeff. is found to be approx. constant at higher frequencies, but to decrease towards zero as the frequency approaches zero. Since excess eddy current and residual losses are both proportional to  $B_m^2$ , they are examined together as of possible common origin, and in relation to the anomalous inductance-frequency characteristic. This characteristic consists of a more rapid decline of inductance with frequency than predictable from the theory of eddy current shielding—S. G.

**\*Energy of Lattice Distortion of Cold-Worked Permalloy.** F. E. Haworth (*Phys. Rev.*, 1937, [ii], 52, (6), 613–620).—The broadening of the (311) reflection caused by cold-working a Permalloy containing 70% nickel was studied with a focussing camera, using Fe  $K\alpha$  radiation. The broadening diminishes on annealing, and recovery is complete at 650° C.; photomicrometer curves of the 311  $K\alpha$  doublet are reproduced. The energy of distortion is calculated by an equation due to Stibitz; the analysis is reproduced (cf. *Met. Abs.*, 1936, 3, 360). After the material had been reduced 96% in cross-sectional area by cold-working, the root-mean-square distortion was 0.31% of the lattice distortion, and the energy of this distortion is 0.065 cal./gram.—W. H.-R.

**Permalloys and Related Ferromagnetic Alloys.** J. C. Chaston (*Rev. Téléph. Télec. T.S.F.*, 1937, 15, (159), 469–479; (160), 540–551).—See *Met. Abs.*, 1936, 3, 393.—R. T.

**\*Single Crystals [of Nickel-Iron Alloy] with Exceptionally High Magnetic Permeabilities.** P. P. Cioffi, H. J. Williams, and R. M. Bozorth (*Phys. Rev.*, 1937, [ii], 51, (11), 1009).—Brief abstract of a paper read before the American Physical Society. Single crystals of purified iron and of a nickel-iron alloy containing 66% nickel were prepared, and some of their magnetic properties were measured. For iron the maximum permeability was 680,000, measured at  $B = 17,800$ . The highest permeability reached for the alloy was 1,040,000, and was attained by combining several factors, each one of which is known to favour high permeability; these factors are: (1) absence of strains associated with hard-working, dissolved impurities and grain boundaries; (2) choice of proper crystallographic direction for magnetization; (3) presence of a magnetic field (in the direction chosen for the test) during annealing; these are of unequal importance in different ferromagnetic metals and alloys, as there may be added (4) appropriate composition. The materials were heat-treated in pure hydrogen just below the melting point. The specimens were cut in the form of hollow rectangles so oriented that each edge was parallel to a tetragonal axis, and so to a direction of easy magnetization. Thus, a closed magnetic circuit, necessary for accurate high permeability measurements, was obtained.—S. G.

**\*On the Relations of Rhenium to Carbon.** W. Trzebiatowski (*Z. anorg. Chem.*, 1937, 223, (4), 376–384).—When rhenium powder is heated in methane at 800°–2200° C., it absorbs a maximum of about 1% of carbon in solid solution, but no carbide is formed. In carbon monoxide, coarse-grained rhenium powder also absorbs about 1% of carbon at 450°–1100° C., but the resulting broadening of the lattice is greater; on heating at higher temperatures, however, this effect disappears. Activated rhenium forms a true carbide at 470°–600° C. in carbon monoxide; this decomposes into carbon and the saturated solid solution at above 1600° C.—A. R. P.



\***Constitution of the Sodium-Gold Alloys.** Communication on Metals and Alloys.—XXIV. W. Haucke (*Z. Elektrochem.*, 1937, 43, (8), 712-719).—Read before the Deutsche Bunsen Gesellschaft. Three intermediate phases were established in the system sodium-gold by means of X-ray analysis, contrary to the results of earlier studies by thermal analysis. In the thermal diagram, the compound  $\text{Au}_2\text{Na}$  has a range of homogeneity from about 32 to over 43 atomic-% sodium. By Debye-Scherrer photographs, a cubic lattice for these crystals was found, with face-centred translations groups:  $a = 7.801 \text{ \AA}$ . for 38.1 atomic-% sodium and 25 atoms per cell. The crystals are of the  $\text{Cu}_2\text{Mg}$  type. Crystals of the  $\gamma$ -phase  $\text{AuNa}_2$  were obtained from alkali-rich alloys by extraction with liquid ammonia. A complete determination of the structure was established for this compound by means of layer-line-, goniometer-, and powder-photographs. The elementary body is tetragonal, and contains 12 atoms per cell,  $a = 7.402$ ,  $c = 5.511 \text{ \AA}$ ,  $c/a = 0.745$ .  $\text{AuNa}_2$  has the same structure as  $\text{CuAl}_2$ . There exists a third intermediate phase,  $\beta'$ , which is perhaps only stable at higher temperatures; its powder diagram was not sufficient for a determination of its structure.—J. H. W.

\***On the Volume Compression of Sodium Potassium and Rubidium on Combination with Gold.** Wilhelm Biltz and Friedrich Weibke (with Udo [Frhr.] Quadt and Hans-Joachim Ehrhorn) (*Z. anorg. Chem.*, 1937, 232, (3), 313-318).—The molecular volumes of alkali metal compounds with gold are calculated, and the increases in molecular volume due to alloying with an alkali metal are plotted against the composition. The graphs are straight lines the slopes of which increase with increasing atomic weight of the alkali metal. The space occupied by the alkali metals in their aurides is much smaller than that occupied by the pure metals.—A. R. P.

\***On the Interaction between Bearing Metals and Lubricants.** Theodor Ranow (*Petroleum Z.*, 1937, 33, (36), 1-8).—A series of running tests on 7 bearing metals and a variety of lubricants, the properties and commercial designation of all of which are tabulated, was undertaken in order to investigate: (a) the differences between the lubricating power of oils of similar viscosity relations; (b) the factors influencing the increase of friction when "fluid" friction is replaced by "mixed" friction; (c) the influence of the nature of the material in both the foregoing studies; and (d) the influence of the composition and of the structure of the bearing surface, and the applicability of these results to other lubricating systems.—P. R.

†**The Constitution of Iron-Titanium Alloys.** George F. Comstock (*Metals Handbook (Amer. Soc. Metals)*, 1936, 284-285).—A critical discussion of the literature, with a bibliography of 8 references. The equilibrium diagram of Lamort is given, with the solubility line added as suggested by Seljesater and Rogers.—S. G.

†**Constitution of Iron-Tungsten Alloys.** W. P. Sykes (*Metals Handbook (Amer. Soc. Metals)*, 1936, 286-287).—S. gives, and discusses, an equilibrium diagram based on the data of Honda and Murakami, Sykes, Arnfelt, and Chartkoff and Sykes. A bibliography of 6 references is appended.—S. G.

†**Constitution of Iron-Vanadium Alloys.** Jerome Strauss (*Metals Handbook (Amer. Soc. Metals)*, 1936, 288-289).—A critical discussion of the literature, with a bibliography of 16 references. An equilibrium diagram is given, based on the work of various investigators.—S. G.

\***On the Reactions of Iron with Liquid Zinc.** Erich Scheil and Hermann Wurst (*Z. Metallkunde*, 1937, 29, (7), 224-229).—The amount of iron dissolved by molten zinc in unit time and the iron content of the alloy film built up on an iron sheet immersed in zinc increase slowly up to  $480^\circ \text{C}$ ., then rapidly to a maximum at  $500^\circ \text{C}$ ., after which both decrease sharply to  $520^\circ \text{C}$ . and then increase again at a similar rate to that which holds for below  $475^\circ \text{C}$ . The rate of thickening of the alloy layer follows a flat parabolic curve below  $480^\circ \text{C}$ .

and above 520° C.; X-ray and micrographic examination show that in both cases the iron becomes covered with the  $\Gamma$ -phase of the zinc-iron system through the layer of which the iron diffuses and reacts at the boundary with the surrounding liquid zinc. Between 480° and 520° C. the  $\Gamma$ -phase is not formed; the zinc is drawn through the alloy layer by capillarity and reacts with the iron at the iron surface so that the alloy layer grows uniformly with time. Addition of up to 1.5% of silicon increases the rate of attack markedly and extends the temperature range of vigorous reaction to 450°-525° C., but with 4.7% silicon the rate of attack is decreased, and no maximum occurs up to 550° C. Addition of manganese decreases the temperature of maximum attack to 475° C. with 0.38% manganese and to below 450° C. with 1.5%; silicon and manganese together considerably increase the rate of attack, whereas aluminium slightly and copper strongly decreases attack. As regards impurities in the zinc, arsenic, copper, and lead are without effect, 2-3% of bismuth, cadmium, antimony, or tin considerably reduce the rate of attack, and as little as 0.16% aluminium almost completely suppresses the vigorous attack at 500° C.—A. R. P.

**Mazak Manual [on Zinc-Base Die-Casting Alloys].** — (*Tech. Bull. Imperial Smelting Corpn.*, 1936, 19 pp.).—Data are presented on the composition, mechanical properties, and dimensional changes of the Mazak zinc-base die-casting alloys Nos. 2, 3, 5, 6, both as cast, after 3 years' normal ageing, and after 6 months' dry anneal at 95° C. Where very close dimensional tolerances are necessary, Mazak 3 may be stabilized by heating for 6 hrs. at 100° C. Notes are included on the effects of impurities on the intercrystalline corrosion of these alloys, and recommendations given for their casting and machining.

—J. C. C.

**Aircraft-Engine Materials.** J. B. Johnson (*S.A.E. Journal*, 1937, 40, (4), 153-162; discussion, 162-164; and *Heat-Treating and Forging*, 1937, 23, (2), 75-79).—A comprehensive review of American practice. Two tables give the properties, composition, and application of the various materials, ferrous and non-ferrous, which are covered by Society of Automotive Engineers' Specifications and used for aircraft work: these tables are annotated by the text, in which, among others, the following points are of interest: effects of inclusion count and grain flow on the fatigue strength of steel forgings; stabilization treatments to reduce dimensional changes in aluminium alloy castings; difference between properties of test-bar and properties of casting; the structure of leaded bronzes; cadmium-plating of steel parts, anodizing of aluminium, and chromate treatment of magnesium. In the discussion, G. D. Welty points out the detrimental effects, of processing treatments and service conditions, on the properties of aluminium alloy castings, and states that improved heat-treatment practice is reducing the necessity for stabilizing treatments. George A. Zink gives the hardness at various temperatures of two leaded bearing bronzes.—H. W. G. H.

**Creep of Non-Ferrous Metals and Alloys.** A Review of Published Information. (Baker.) See p. 487.

**\*Contribution to the Determination of the Flowing Properties of Liquid Metals [and Alloys].** (Ruff.) See p. 489.

**Theories of Age-Hardening.** — (*Metallurgist (Suppl. to Engineer)*, 1937, 11, 18-19).—A critical consideration of recent theories put forward by Cohen and Gayler, and of discussions which have taken place on these. The major problem, however, is the origin of the specific nature of the phenomenon of age-hardening. The work reviewed is considered to have served a useful purpose in exposing the weakness of the older methods of classifying age-hardening alloys, but the finding of improved materials requires a more constructive theory, leading to the recognition of the peculiarity other than thermodynamic instability, which causes a solution to give hardening.—R. G.



**On the Thermal Effects Associated with the Ageing Process.** J. Czochralski, R. Smoluchowski, and H. Całus (*Wiadomości Instytutu Metalurgii i Metaloznawstwa*, 1937, 4, (2), 45-49).—[In Polish, with English summary.] Measurements of heat effects associated with ageing processes in metals, carried out by Polish investigators, are briefly referred to, and an adiabatic modification of the calorimetric method used is described. The total heat effect associated with the quenching of Duralumin from 510° C. equals  $1.67 \pm 0.05$  cal./gram. It is suggested that the ageing process comprises two stages: (1) a stage in which the dissolved atoms diffuse to certain regions of the crystal lattice, and (2) a process of formation and crystallization of molecules of the precipitating compound.—J. S. G. T.

**\*Coercive Force in Single Crystals.** K. J. Sixtus (*Phys. Rev.*, 1937, [ii], 52, (4), 347-352).—The coercive force  $H_c$  of 10 single crystal discs of silicon-iron was measured in different directions in their planes. In any one disc,  $H_c$  changes with the direction, and is determined mainly by the angle  $\alpha_3$  between the field and the [001] axis nearly normal to the disc, and has a minimum value when that angle is 90°. The angle  $\alpha_1$  between the field direction, and another cubic axis which lies nearly in the plane of the disc and close to the field direction, has a smaller effect on  $H_c$ . The empirical relation  $H_c = A/\cos \alpha_1 + B \cos \alpha_3$  is in good agreement with the results for well-annealed discs. The effects of varying the shape of the discs, and of increasing the internal strain by carburization were studied.—W. H.-R.

**\*Precise Magnetic Torque Measurements on Single Crystals of [Silicon-]Iron.** [Magnetic Method for Determining the Orientation of Ferromagnetic Single Crystals.] L. P. Tarasov and F. Bitter (*Phys. Rev.*, 1937, [ii], 52, (4), 353-360).—Cf. preceding abstract. A balance is described with a rotating magnet giving a field of over 3000 oersteds. This is used for determining magnetic torque curves of single crystal discs as the magnet is turned to produce magnetization in different directions. A method is developed which, with certain limitations, enables the crystal orientation to be determined from the positions of the angles of zero torque. Cylindrical discs introduce errors which may be avoided by the use of ellipsoids. Results for single crystals of silicon-iron are given, and compared with X-ray orientation measurements.—W. H.-R.

**The Chemistry of Intermetallic Compounds.** U. Dehlinger (*Naturwiss.*, 1936, 24, (25), 391-395).—The law of multiple proportions does not apply to the formation of intermetallic compounds. After reviewing the literature on attempts to systematize the formation of intermediate phases in metal systems, the difference between a so-called classical compound and an intermetallic compound is discussed from the point of view of the electronic theory. Experimental data which form a basis for further researches and for developing a satisfactory theory are reviewed.—B. Bl.

**\*The Heat of Formation of Binary and Ternary Alloys and Its Importance in Metallurgical Reactions [Fe-Sb, Co-Sb, Ni-Sb, Fe-Al-Si, Cu-Ni-Al].** Willy Oelsen (*Z. Elektrochem.*, 1937, 43, (8), 530-535).—Read before the Deutsche Bunsen-Gesellschaft. Continuing the investigation of F. Körber (*Met. Abs.*, this vol., p. 91) on the heat of formation of alloys, further results are given, obtained by the simple process of pouring the components together. The heat of formation of the binary alloys iron-antimony, cobalt-antimony, and nickel-antimony and the ternary alloys iron-aluminium-silicon and copper-nickel-aluminium, were determined for the whole ranges of compositions and brought into relation with the equilibrium diagram. The heat capacities of some alloy series in the solid and liquid states, the decompositions occurring during solidification, and the dissociation of the compounds in melting were investigated. From the results, conclusions are reached for the metallurgical behaviour of the different constituents in metal mixing.—J. H. W.

\***Solubility Limits of Intermetallic Phases.** F. Halla (*Z. Elektrochem.*, 1937, 43, (8), 558-560).—It was assumed that the density of an intermetallic phase mostly lies between the densities of the pure components. If there exists the possibility of estimating the density of the next unknown phase of determined composition by inter- or extra-polation, this hypothesis gives a criterion of instability; the phase will be unstable if the so determined density lies beyond the specified density range. This criterion was tested with the intermetallic phases XY and  $X_2Y$  (X = manganese, iron, cobalt, nickel, copper; Y = phosphorus, arsenic, antimony), and found to be true in an overwhelming number of cases. A discussion follows.—J. H. W.

**A Simple Systematic Classification of All Binary or Ternary Alloys.** E. Jänecke (*Forschungen u. Fortschritte*, 1936, 12, 204-206).—See *Met. Abs.*, 1936, 3, 153, 302.—S. G.

\***On the Theoretical Methods of Constructing Alloy Equilibrium Diagrams.** S. T. Konobejewski (*Izvestia Akademii Nauk S.S.S.R. (Bull. Acad. Sci. U.R.S.S.)*, 1936, [Chim.], (2), 255-270).—[In Russian, with French summary.] See *Met. Abs.*, 1936, 3, 524.—N. A.

\***Application of Hahn's Emanation Method to Metal Problems.** Wolfgang Seith and Günther Küberle (*Z. Metallkunde*, 1937, 29, (7), 218-222).—When hard-worked silver impregnated with thorium-X is heated, changes occur in the radioactivity at 90° C. (only a slight inflexion) due to the onset of recrystallization, and at about 200° C. (well-defined maximum in the curve) due to the beginning of grain-growth. A gold-copper alloy with 50 atomic-% gold similarly impregnated shows a well-marked point of inflexion in the activity curve at 300° C., both during heating and cooling; this is held to indicate the beginning of an increase in mobility of the atoms prior to the order-disorder transformation. The thorium-X method can also be used to determine the temperature of a polymorphic transformation (e.g. the  $\alpha$ - $\gamma$  change in nickel-iron alloys), the grain-growth and diffusion in compressed metallic powders during sintering, the formation of compounds in mixtures of such powders (e.g. in briquettes of antimony and copper powders), and the rate of diffusion of one metal in another.—A. R. P.

### III.—STRUCTURE

(Metallography; Macrography; Crystal Structure.)

(Continued from pp. 437-441.)

**The Reproduction of Equilibrium Diagrams.** J. L. Haughton (*Monthly J. Inst. Metals*, 1937, 4, (2), 79-82; correction, (4), 223).—The usefulness of equilibrium diagrams would be enhanced by the exclusive use of the Centigrade temperature scale, the indication of both weight and atomic-%, and the drawing of the diagram to a scale permitting accurate measurement in the reproduction. H. advises standard symbols for experimental points, tabulation of the coordinates of principal points, clear indication of incompletely determined lines, and differentiation of phase changes from other transformations. Systems of nomenclature, based on the components' relative practical importance, or on the alphabetical order of their symbols, are discussed, phases being named in order from left to right of the diagram, with decrease of temperature and of the content of the principal metal. Application to ternary diagrams is considered. (See also abstract below).—G. V. R.

**Nomenclature in Equilibrium Diagrams.** A. J. Bradley (*Monthly J. Inst. Metals*, 1937, 4, (4), 222-223).—A consecutive alphabetical system of nomenclature (see Haughton, preceding abstract) would lead to confusion if new phases were discovered, conceals structural phase relationships, and does not easily apply to complex systems. B. suggests naming by similar letters



phases of similar crystal structures, irrespective of their position in the diagram. With certain exceptions, solid solutions of face-centred cubic, body-centred cubic, and close-packed hexagonal structures should be termed  $\alpha$ ,  $\beta$ , and  $\epsilon$ , respectively. Adjacent phases of similar crystal structure may be distinguished by subscript figures. The ease of application to complex systems is shown.—G. V. R.

**\*Investigation of Equilibrium Diagrams of Ternary Alloys by X-rays.** A. J. Bradley, H. J. Goldschmidt, H. Lipson, and A. Taylor (*Nature*, 1937, 140, (3543), 543–544).—The investigation of ternary systems by X-rays is discussed, and the diagram for the copper-nickel-aluminium system, after slow cooling at a definite rate (not necessarily equilibrium), is given. Each X-ray photograph can give information regarding: (a) the number of phases present; (b) the type of each phase; (c) the lattice spacing of each phase; and (d) the relative amounts of each phase. By using the three known binary diagrams, it is possible to complete the ternary diagram with comparatively few specimens. The nomenclature of the phases is discussed.—B. C.

**Glossary of Terms Used in X-Ray Metallography.** L. W. McKechnan (*Metals Handbook (Amer. Soc. Metals)*, 1936, 78–84).—A revision and extension of the glossary previously published in *Proc. Amer. Soc. Test. Mat.*, 1926, 26, (1), 582. A short list is appended of German terms with English equivalents.—S. G.

**Classification of Intermetallic Phases.** Juan M. Coronas (*Anales soc. españ. fis. quim.*, 1936, 34, 225–240).—A review of the literature.—S. G.

**An Attempt at a Molecular Theory of Liquid Structure.** J. D. Bernal (*Trans. Faraday Soc.*, 1937, 33, (1), 27–40; discussion, 40–45).—Assuming that the molecular structure of a simple liquid is coherent and homogeneous, it can always be represented statistically by a distribution function determined by 3 variables only, viz. the mean distance of closest approach of the molecules ( $r_1$ ), the number of close neighbours of any molecule ( $\bar{N}$ ), and the irregularity of distribution ( $\lambda$ ). The actual configuration of any liquid can be derived from a knowledge of the intermolecular potential function alone, by using the two conditions of minimum potential energy in relation to changes in  $r_1$ , and minimum free energy in relation to changes in  $\bar{N}$  and  $\lambda$ . The effects produced by changes in temperature and pressure in liquids differ fundamentally from those in solids, since the configuration is not even approximately constant, but is a function of temperature and pressure. On this basis, the greater specific heat and compressibility can be explained. Further, liquids and solids may be shown not to form part of any continuous state, since they are separated (according to this theory) by regions of geometrically unrealizable intermediate states, and there is thus no reason to expect critical point phenomena between the solid and liquid states. A general classification of liquids, based on this theory and including liquid metals, is attempted.—A. R. P.

**On the Range of Stability of the Fluid State.** F. Simon (*Trans. Faraday Soc.*, 1937, 33, (1), 65–73).—Theoretical. No experimental data are yet available that would exclude the existence of a continuity between the crystalline and fluid states. Along the melting curve the entropies of the solid and liquid phases approach an intermediate value, showing a growing similarity between these phases with increasing temperature. This has been confirmed experimentally for potassium and sodium.—A. R. P.

**The Preparation of Metallographic Specimens.** H. M. Boylston (*Metals Handbook (Amer. Soc. Metals)*, 1936, 554–562).—The tables of etching solutions accompanying this article are for ferrous materials only.—S. G.

**Metallographic Grinding and Polishing.** E. Haardt (*Schlieff u. Poliertechn.*, 1935, 14, (4), 69; *Ceram. Abs.*, 1936, 15, 75).—The usual process for the cutting, grinding, and polishing of metallographic specimens is described. The granulometry of successive abrasives is given. Soft metals and soft materials are more difficult to deal with. Particulars are given for special cases.—S. G.

**Photomicrography.** H. M. Boylston (*Metals Handbook (Amer. Soc. Metals)*, 1936, 563-572).—S. G.

**Erroneous Interpretations of Studies Under Polarized Light.** Albert M. Portevin (*Metal Progress*, 1937, 32, (1), 63-64).—The limitations of metallographic examination by means of polarized light are discussed; they include possible faulty interpretation of parasitical reflection phenomena which suggest bi-refringent properties. The "black cross" appearance does not necessarily indicate the existence of internal stress, as is shown by its existence in glycerin droplets. Apparently bi-refringent inclusions should be examined by conic light.—P. R.

**The Estimation of Intergranular Surfaces and Volumes in Metals.** Herman F. Kaiser (*Phys. Rev.*, 1937, [ii], 51, (11), 1015).—Brief abstract of a paper read before the American Physical Society. In many cases the intergranular surfaces of separation of metals suggest an almost regular geometrical structure. For such cases it is possible to carry out an approximate treatment by visualizing the metal as built up of regular space-filling parallelehedra. In the paper (presumably to be published in due course) expressions are derived, using the four parallelehedra of Fedorov, for the internal surface, the intergranular volume, and the density of the model metal as functions of the grain-size and composition of the metal. Results are applied to the computation of amounts of totally insoluble impurities required to produce grain envelopes of given thickness. The bearing on Tammann's theory of recrystallization is discussed in the paper.—S. G.

**\*A Study of the Rearrangement of the Crystals of a Metal by its Recrystallization.** Usaburo Yoshida and Saburo Nagata (*Mem. Coll. Sci. Kyoto Imp. Univ.*, 1936, 19, (5), 207-213).—[In English.] In continuation of previous work (*Met. Abs.*, 1936, 3, 357), Y. and N. studied the grain-growth of crystals in thin, cold-worked, commercial aluminium plates. Growth occurs in two stages: (1) primary grain-growth to moderate size, and (2) secondary grain-growth to large size from moderate size. In the case of the recrystallization at 630° C. of single crystal plates of aluminium strained by elongation, when the elongation < about 2% the new crystal retained the orientation of one of the crystallites formed during straining; when the elongation > about 3% the orientation of the crystal formed by recrystallization was independent of those of the original crystallites; between these two limits a mixture of these orientations was observed. In recrystallization at 610° C., the recrystallized crystals did not recover the orientation of the original crystallites, even when the elongation was < 2%. A mechanism of these phenomena is discussed.—J. S. G. T.

**Notes on the Grain-Size of Cast Ni-Cr Heat-Resisting Alloys.** F. K. Ziegler and L. B. Haughwout (*Metals and Alloys*, 1937, 8, (8), 225-229).—The carbide network in cast nickel-chromium alloys containing nickel 65, chromium 15, carbon up to 0.75% and iron the remainder, bears no definite relation to the actual grain boundaries. The network is broken up by a prolonged high temperature anneal and the carbide distribution is then random. Etching reagents which develop the carbide constituents do not reveal the grain boundaries of cast alloys. Characteristic structures are illustrated.—A. R. P.

**\*An Examination of the Imperfection of Aluminium Crystals.** Masaharu Kabata (*Mem. Coll. Sci. Kyoto Imp. Univ.*, 1936, 19, (5), 223-228).—[In English.] By crystal analysis, employing convergent X-rays, K. found that the stress-annealing method did not produce a perfect thin single-crystal of aluminium. The angle of rotation of crystal fragments was 20'-30' about the [211] axis.—J. S. G. T.

**\*Structure of Aluminium-Magnesium Alloys.** E. Möckel (*Aluminium*, 1937, 19, (7), 433-439).—For developing the microstructure of magnesium-aluminium alloys, a 30 minutes' etch in cold 9% phosphoric acid is recommended; Mg<sub>2</sub>Si



is coloured black,  $Mg_2Al_3$  a light grey, and the ternary Al-Mn-Fe compound a dark grey. Since this ternary compound is insoluble in aluminium, and is also very brittle, the iron content of these alloys should be kept to the lowest possible limit, and the manganese content should not exceed 0.3–0.4%; the  $Mg_2Si$  content should also be kept as low as possible. Characteristic structures of the 7% magnesium-aluminium alloy after various heat-treatments, and in the rolled state, are illustrated.—A. R. P.

**\*The Structure of Eutectic Alloys: Its Variation by Rolling and Heating.** Gustav Tammann and Hans Hartmann (*Z. Metallkunde*, 1937, 29, (5), 141–144).—In the solidification of many eutectic alloys, e.g. lead-tin, zinc-tin, cadmium-tin, the polyhedral crystals grow from crystallization nuclei from which radiate fibrous bundles of needles of the less abundant component, to produce the appearance of a spherulitic fibrous mass in a groundwork of the more abundant constituent. In eutectics with a brittle constituent, e.g. silicon-aluminium or silicon-silver, the ground-mass of major constituent contains regularly-dispersed particles of the brittle constituent with an irregular contour. In the antimony-lead and cuprous oxide-copper eutectics the lead and copper form polyhedral crystals, in which the antimony and cuprous oxide are dispersed in short fibres of uniform size regularly distributed throughout the crystals, but with different orientations in each crystal; in the copper eutectic the oxide particles are thickened towards the boundaries of the crystals, and there is a narrow area in which no oxide can be detected. On rolling eutectic alloys, edge-cracking appears at 90% reduction with the tin-cadmium, 98% with the zinc-tin, 60% with the lead-cadmium, 75% with the lead-tin, 90% with the lead-bismuth, 50% with the silicon-aluminium, 15% with the bismuth-tin, and 25% with the silver-tin alloy. During the rolling operation the fibres of the spherulites first bend over, then elongate, and finally form undulating streaks in the direction of rolling, so that a micrograph of the rolled surface appears to show that a change has occurred in the proportions of the two constituents present; generally the harder constituent seems to become less abundant. On annealing the rolled alloys, the elongated fibres start to shrink up and thicken; a similar tendency is sometimes observed when the alloy is annealed at 10°–20° C. below the melting point without previous rolling. By extremely rapid cooling of a molten eutectic it is possible to cause it to solidify in the glassy amorphous form, since the presence of two or more metals together tends to reduce the rate of crystallization of all of them. This effect is most marked in polynary eutectics, e.g. when molten Wood's metal is quenched in liquid air in small drops these are extremely brittle, have a glassy fracture, and show no signs of crystallization. Plastic deformation of cubes of the cuprous oxide-copper eutectic by compression results in the formation of slip planes the orientation of which varies from crystal to crystal, indicating that the copper itself forms a coherent crystal in which the oxide particles are regularly embedded.—A. R. P.

**\*An Electron Diffraction Study of the Effect of Heat upon the Structure of Gold Leaf.** G. L. Clark and E. Wolthuis (*J. Applied Physics*, 1937, 8, (9), 630–638).—The construction of an electron diffraction apparatus, adapted to both reflection and transmission studies of crystalline substances, is described. Microscopic, X-ray, and electron diffraction evidence shows that at 400° C. the gold in a leaf of gold flows into aggregates or larger crystal grains. A "many ring" pattern observed when the leaf is heated in air or oxygen is attributed to the formation of an oxide which is rather unstable at about 400° C.—J. S. G. T.

**Electronic Analysis: Oxidation of Gold-Copper Alloys.** Jean Trillat, S. Oketani, and S. Miyaké (*J. Phys. Radium*, 1937, 8, (9), 353–354).—The modification of structure found when gold leaf containing about 1% of copper is heated in air at 400°–550° C. (*Met. Abs.*, this vol., p. 180) is now ascribed to the

production of a superficial film of an oxide of copper closely resembling tenorite (CuO), and which is transformed into the latter on heating. The production of the oxide is attributed to migration of the copper atoms to the surface of the gold leaf and their subsequent oxidation.—J. S. G. T.

**\*The Structure of Electrodeposited Nickel.** G. I. Finch and A. L. Williams (*J. Electrodepositors' Tech. Soc.*, 1937, 12, 105-110; *Met. Ind. (Lond.)*, 1937, 50, (16), 465-468; discussion, 468-470).—See *Met. Abs.*, this vol., p. 189.—S. G.

**\*Some New Results and General Interpretation of Diffraction by Amorphous Substances.** J. A. Prins (*Trans. Faraday Soc.*, 1937, 33, (1), 110-112).—Liquid Wood's metal, tin, and bismuth give diffraction patterns more or less resembling that given by mercury, but oxide films cause interference. Clearer results are obtained with selenium, since the oxide is volatile. Amorphous antimony obtained by electrolysis gives a pattern identical with that given by films produced by vacuum evaporation.—A. R. P.

**†Uses and Limitations of X-Ray Diffraction Methods.** John T. Norton (*J. Applied Physics*, 1937, 8, (5), 307-312).—Read at a Symposium on Metals, Cambridge, Mass., U.S.A.—The usefulness of X-ray diffraction methods as an industrial tool is critically examined. Among matters interestingly discussed are: the interpretation of diffractive evidence, phase precipitation, directional properties in worked or heat-treated sheets, crystal distortion and orientation, grain-size, and the measurement of elastic stress. Four forms of X-ray appliances recently introduced are illustrated. N. stresses the need for intelligent direction by someone able to resolve metallurgical problems into their fundamental aspects.—J. S. G. T.

**A Correlated Abstract on Superlattices.** Charles S. Barrett (*Metals and Alloys*, 1937, 8, (9), 251-256, 260).—A review of recent work.—A. R. P.

**\*Modification of Atomic Volumes in the Systems Cu-Zn, Ag-Zn, and Au-Zn.** Otto Weinbaum (*Rev. chim. ind. (Rio de Janeiro)*, 1936, 6, 146-148; *C. Abs.*, 1937, 31, 6519).—Atomic volumes are calculated for 3 cubic and 2 hexagonal phases of solid solutions of the 3 alloy systems. In silver-zinc and gold-zinc alloys the volume decreases as the proportion of zinc increases, whereas the reverse is the case with copper-zinc alloys.—S. G.

**Some Patterns in Sputtered [Metal] Films.** Raymond Ellickson (*Rev. Sci. Instruments*, 1936, [N.S.], 7, (11), 436).—Attention is directed to patterns produced on cathodes due to sputtering from anodes at various distances from the cathode, or through various apertures.—J. S. G. T.

**Effect of Small Deformations on the Fine Structure Röntgenograms of Metals [Aluminium, Copper, Nickel, and Steel].** Erich Martin (*Arch. Eisenhüttenwesen*, 1936-1937, 10, (9), 415-417).—Debye-Scherrer röntgenograms of annealed copper, aluminium, nickel, and steel wires under gradually increasing loads show well-defined changes when the elastic limit is exceeded; the spots of which the individual lines are made up begin to elongate when the loads exceed this limit and their intensity decreases. With further increase in load, the elongated spots merge into single continuous lines, but with some specimens this stage may not be reached before fracture occurs. Characteristic röntgenograms are included of the metals under various loads up to the ultimate stress.—A. R. P.

**\*X-Ray Study of Surface Aluminium-Copper Alloys Formed in a Primary Cell.** D. P. Zosimovich, M. V. Buchkovskii, and O. M. Brenaizen (*Zapiski Institutu Khemii, Ukrain'ska Akademia Nauk (Mem. Inst. Chem. Ukrain. Acad. Sci.)*, 1936, 3, 237-247; *Brit. Chem. Abs.*, 1937, [A1], 33).—In Ukrainian.] The amount of aluminium which combines with copper in the action of the fused electrolyte cell  $\text{Al}|\text{AlCl}_3\text{-NaCl}|\text{Cu}$  increases with the temperature from 200° to 550° C.  $\alpha$ -Cu-Al is formed at 200°-300° C., and transition to the  $\gamma$  alloy takes place at 300°-350° C.  $\beta$ -Cu-Al was not formed.

—S. G.



\*Alloy Phases with a Fluorite Structure [ $\text{AuAl}_2$ ,  $\text{AuGa}_2$ ,  $\text{AuIn}_2$ ,  $\text{PtAl}_2$ ,  $\text{PtGa}_2$ ,  $\text{PtIn}_2$ ]. E. Zintl, A. Harder, and W. Haucke (*Z. physikal. Chem.*, 1937, [B], 35, (5), 354–362).—The compounds  $\text{AuAl}_2$  ( $a = 6.00$  A.),  $\text{AuGa}_2$  ( $a = 6.063$  A.),  $\text{AuIn}_2$  ( $a = 6.502$  A.),  $\text{PtAl}_2$  ( $a = 5.910$  A.),  $\text{PtGa}_2$  ( $a = 5.911$  A.), and  $\text{PtIn}_2$  ( $a = 6.353$  A.) have a cubic lattice of the fluorite type; all have a remarkable colour, and a high heat of formation.  $\text{PtGa}_2$  and  $\text{PtIn}_2$  are stable only at high temperatures, but can be retained by quenching; on reheating the quenched alloys at  $200^\circ\text{C}$ . they transform into products with a complex lattice structure.—v. G.

\*Experiments on the Variation of the Atomic Structure Factor of Nickel with X-Ray Wave-Length. William P. Jesso (*Phys. Rev.*, 1937, [ii], 52, (5), 443–451).—The atomic structure factor of nickel was studied experimentally for wave-lengths in the region of the  $K$  absorption edge, and the variations are compared with those to be expected on theoretical grounds.

—W. H.-R.

\*Determination of the Orientation of Metallic Crystals. J. Czochochalski and J. Skowrońska (*Wiadomości Instytutu Metalurgii i Metaloznawstwa (Warszawa)*, 1937, 4, (1), 26–29).—[In Polish, with German summary.] The orientations of single crystals of zinc, aluminium, copper, and antimony are determined without the use of X-rays by observation of etch effects. A study of etch figures and reflections, as well as slip-planes and twin formation, is shown to determine the orientation of the crystals with an accuracy which for many purposes may be regarded as sufficient.—P. W. R.

\*Asymmetry in Metals of Hexagonal Structure. G. W. Brindley and P. Ridley (*Nature*, 1937, 140, (3541), 461–462).—The departure of the  $c/a$  ratio from the value 1.633 (corresponding to spheres in hexagonal packing) for zinc and cadmium is explained as being due to atomic asymmetry, the atoms being more diffuse along the  $C$  axis. Results are given of a new investigation on ruthenium ( $c/a = 1.58$ ) which provides evidence for a new type of asymmetry, tentative explanation in terms of an assumed distribution of electron density being given.—B. C.

\*Application of the Virial Theorem to Approximate Molecular and Metallic Eigen-functions. J. O. Hirschfelder and J. F. Kincaid (*Phys. Rev.*, 1937, [ii], 52, (6), 658–661).—Theoretical.—W. H.-R.

\*Effect of Time-Reversal Symmetry on Energy Bands of Crystals. Conyers Herring (*Phys. Rev.*, 1937, [ii], 52, (4), 361–365).—A theoretical development of the theory of Brillouin zones in metallic crystals.—W. H.-R.

\*Accidental Degeneracy in the Energy Bands of Crystals. Conyers Herring (*Phys. Rev.*, 1937, [ii], 52, (4), 365–373).—A theoretical development of the theory of Brillouin zones in metallic crystals.—W. H.-R.

\*The Scattering of X-Rays by Crystals in the Region of the Curie Point. L. Landau (*Physikal. Z. Sowjetunion*, 1937, 12, (2), 123–137).—[In German.] Formulæ are derived for the coherent and incoherent scattering of X-rays by crystals in the region of the Curie point, and the dependence of the intensity of scattering on temperature is studied. By means of the formulæ deduced, the distributions of intensity in Laue diagram spots and in Debye-Scherrer rings are studied.—J. S. G. T.

\*Two Experiments on [Tensile] Strength [of Crystals]. A. W. Stepanow (*Physikal. Z. Sowjetunion*, 1937, 12, (2), 182–190).—[In English.] By experiments in which the effect of plastic deformation was respectively reduced or increased, the tensile strength of rock salt crystals was increased or reduced from its normal value of 500  $\text{grm./mm.}^2$  to values between 2000 and 80  $\text{grm./mm.}^2$ . Analogous results were obtained with other crystals, including single crystals of zinc. S. concludes that the low value of the tensile strength of crystals is due to plastic deformation.—J. S. G. T.

\*The Effect of a Groove on the Strength of Mono-Crystals of Rock Salt. I.—Effect of a Rectangular Groove. A. W. Stepanow (*Physikal. Z. Sowjetunion*, 1937, 12, (2), 191–214).—[In English.] Plastic deformation of rock salt crystals under tension is hindered by the presence of a deep transverse groove in the crystal; the tensile strength of the crystal is thereby increased. The effects of dimensions of the groove, its state and profile, erosion by solution, and annealing, are studied. Embryonic cracks affecting the strength of the crystals are of dimensions  $\approx 3 \times 10^{-4}$  cm.—J. S. G. T.

#### IV.—CORROSION

(Continued from pp. 441–445.)

\*Surface Attack on Light Metals. Herm. A. J. Stelljes (*Aluminium*, 1937, 19, (5), 291–298).—Some corrosion phenomena observed in aluminium domestic utensils are illustrated and discussed. Condensation of water during storage may cause local corrosion if the surrounding atmosphere contains smoke gases or salt-spray. Carbide, nitride, oxide, or other non-metallic inclusions may produce local pitting, and some types of commercial cleaning materials also have a deleterious effect on aluminium.—A. R. P.

\*On the Size of the Hydrogen Bubbles on Aluminium in Hydrochloric Acid. E. Jenckel and H. Hammes (*Z. anorg. Chem.*, 1937, 223, (4), 415–423).—The bubble diameter increases with the rate of evolution of hydrogen, but the number of bubbles decreases, and those which remain attached to the aluminium grow larger; at low evolution rates the bubbles are small, and detach more easily. These facts are discussed theoretically, and explained on the basis of electrochemical and surface tension considerations.—A. R. P.

Corrosion of Aluminium Vessels in Breweries. W. Vinz (*Korrosion u. Metallschutz*, 1937, 13, (3), 90–91).—Zones of black spots consisting of small pits of different depths were observed in aluminium vats in a brewery; these occurred in the walls in close proximity to copper cooling-coils, and were traced to electrolytic action between the copper and aluminium. This difficulty can be overcome by using aluminium coils, or by effectively insulating the copper.—A. R. P.

\*On the Resistance to Sea-Water of Forgeable Aluminium Alloys Used in Aircraft Construction. F. Bollenrath and H. Gröber (*Aluminium*, 1937, 19, (6), 349–358; discussion, 391).—Efficient protection of alloys of the Duralumin type against corrosion by sea-water is obtained only by cladding the sheet with pure aluminium. For constructional work, this has several disadvantages, *viz.* protection is limited by the thickness (which determines the life) of the coating; corrosion is likely to occur in rivet holes, with consequent loosening of the rivets; gas-welding reduces the strength of the joint, and resistance welding results in diffusion of copper into the cladding, thus reducing its protective value. Magnesium (7–9%)–aluminium alloys have high strength and resistance to corrosion, and can be welded without reduction of strength, but alloys with more than 7% magnesium (*i.e.* the strongest alloys) are liable to intercrystalline corrosion, due to precipitation of magnesium-rich solid solution at grain boundaries and along slip planes, and to stress concentrations produced by cold-work. Addition of small amounts of titanium, chromium, or zinc to 7–8% magnesium–aluminium alloys increases the strength without inducing loss of corrosion-resistance. Methods of riveting and of surface-protecting light alloys are briefly described.—A. R. P.

\*The Corrosion of Duralumin and Aluminium by Sea-Water. V. M. Fokeev and A. A. Sovalova (*Vestnik Inzenerov i Tehnikov (Messenger Eng. and Tech.)*, 1937, (1), 51–54).—[In Russian.] A study was made of the corrosion of Duralumin and aluminium by solutions whose compositions corresponded



to those of the waters from different seas. The order of decreasing corrosive action was found to be: (1) ocean; (2) Azov Sea; (3) Aral Sea; (4) Caspian Sea; (5) Black Sea; (6) Baltic Sea. Ocean water attacks Duralumin less strongly than aluminium. In all the other solutions investigated, aluminium is the more resistant of the two materials. The experiments reveal a periodicity of attack, caused by the alternative accumulation and scaling off of the corrosion products. A surface layer of aluminium on Duralumin affords a sufficient protection for Duralumin against corrosion by sea-water.

—N. A.

\*On the Change in Tensile Properties and Corrosion-Resistance of the Aluminium-Copper-Magnesium Alloy DM 31 by Cold-Deformation. (Bungardt.) See p. 493.

\*Corrosion Under the Influence of Falling Drops of Corroding Liquid [Aluminium, Elektron, Steel]. G. Welter and S. Gočkowski (*Wiadomości Instytutu Metalurgii i Metaloznawstwa*, 1937, 4, (2), 73-77).—[In Polish, with full German summary.] The corrosive effect of drops of a 3% solution of common salt, falling from a height of 1.5-5 m. upon 4 different aluminium alloys (including Duralumin), a magnesium alloy of the Elektron type, and a mild carbon steel is compared with that produced by merely wetting the test-pieces with the solution. The subject is studied both qualitatively and quantitatively. In the case of the aluminium alloys, deep pitting, and even penetration, of the material occurs under impact of the drops; in the case of the magnesium alloy and the mild steel, the corrosion is more superficial. In all cases the falling drops caused much more corrosion than the stationary fluid, and also caused a markedly greater decrease of tensile strength of one of the aluminium alloys.—J. S. G. T.

\*The Effect of Boiling in Distilled Water and in 2-3% Water-Glass Solution on the Resistance to Corrosion of the MBV Film [on Aluminium and Its Alloys]. Werner Helling (*Aluminium*, 1937, 19, (7), 447-448).—Boiling the filmed metal in water results in leaching out of the excess of chromic acid derived from the filming solution, in swelling of the film with consequent closing of the pores, in a brightening of the colour of the film, and in ageing of the film whereby its resistance to corrosion by alkaline media is increased. Treatment of the film with hot, 3% water-glass solution still further closes the pores and hardens the film so that the treated metal will remain quite inert for 10 minutes in 10% caustic soda solution at 20° C.—A. R. P.

Deterioration of Fusible Alloys in Sprinklers. S. F. Barclay (*Monthly J. Inst. Metals*, 1937, 4, (7), 353-354).—Wood's alloy (melting point 168° F.), widely used in automatic fire sprinklers, shows no measurable deterioration after 50 years if protected from corrosion. In industrial and coastal localities condensation of moisture on the alloy causes corrosion and noticeable deterioration after 10 years. The corrosion process, probably analogous to the dezincification of brass, removes a constituent of the alloy and increases its melting point; beads of molten alloy exude at the working temperature, but the valve fails to open. Protective coatings prove unsuccessful.—G. V. R.

\*A Note on Copper Patina. Peter R. Kosting (*Bull. Amer. Soc. Test. Mat.*, 1937, (87), 18-19).—Examination, by the Debye-Scherrer X-ray diffraction method, of samples of copper patina weathered at Washington, D.C., Upper Montclair, N.J., and Watertown, Mass., U.S.A., showed them to consist of two layers, the upper one of brochantite and the lower one, adjacent to the copper, of cuprite. Only antherite was found in the patina on copper treated by accelerated weathering in the laboratory.—J. C. C.

\*Retgressive Corrosion of Antique Bronze and Copper Objects. Rutherford J. Gettens (*Mouseion*, 1936, (35/36), 20 pp.; *C. Abs.*, 1937, 31, 6603).—The phenomenon of progressive corrosion of antique metal objects, due to the interaction of soluble cuprous chloride with the metal surface, when the

humidity of the atmosphere exceeds approx. 70%, are discussed in detail. A number of experiments concerning the electrolytic reduction of such corroded objects in order to restore their original shape and to eliminate the soluble chlorides are described. Numerous photomicrographs, derived from cross-sections of an antique bronze tool, are given.—S. G.

\*On the Corrosion of Brass by a Humid Ammoniacal Atmosphere. J. Czochralski and H. Schreiber (*Wiadomości Instytutu Metalurgii i Metaloznawstwa (Warszawa)*, 1937, 4, (1), 3-6; *Korrosion u. Metallschutz*, 1937, 13, (6), 181-183; and (summary) *Metallurgist* (suppt. to *Engineer*), 1937, 11, 61-62).—[In Polish, with German summary.] The decrease in tensile strength and elongation of sheet brass (60 : 40, 67 : 33) and Tombak (80 : 20, 85 : 15) caused by the action over various periods of damp ammonia in the presence of air at room temperature was determined. In the cases of the 60 : 40 and 67 : 33 brasses, the results were compared with those for rolled sheets previously annealed for 25 minutes at 325° C. to remove most of the internal strain; the latter were found to be much more resistant to corrosion. The zinc content also exerts a great influence on the rate of corrosion, and consequent decrease in mechanical strength. The corrosion was in all cases intercrystalline. After an induction period of 3-4 hrs. for the 60 : 40 and 67 : 33 brasses and 6-8 hrs. for the others, the material was rapidly attacked and soon completely destroyed.—P. W. R.

\*Studies in the Corrosion Problem of Condenser Tubes.—III, —IV. Tomojiro Tanabe, Goro Koiso, and Masuo Yata (*Trans. Soc. Mech. Eng. Japan*, 1937, 3, (11), 135-141).—[In Japanese, with English summary in foreign edition, pp. 28-29.] Corrosion tests on condenser tubes with cooling water having a velocity of 2-4 m./second, the temperature on the steam side being about 80° C. and on the cooling water side 7°-27° C., were carried out with Admiralty metal, Albrac, cupro-nickel, aluminium-brasses, and "Alumi-brass." Admiralty metal (copper 70, zinc 29, tin 1%) was unsatisfactory, a number of tubes of this material being penetrated by erosion. Albrac (copper 78.5, aluminium 2, silicon 0.3, arsenic 0.05%; zinc remainder) was superior to all others. "Alumi-brass" (copper 82, nickel 1.5, aluminium 4.2, chromium 0.05%; zinc remainder) was subject to dezincification and pitting. Aluminium-brasses were good, next to "Albrac." Cupro-nickel (copper 70, nickel 30%) possessed high resistance to corrosion and erosion.

—J. S. G. T.

Prevention of Failures of Surface-Condenser Tubes. R. E. Dillon, G. C. Eaton, and H. Peters (*Power Plant Eng.*, 1937, 41, (8), 496-498).—Failures due to dezincification in Admiralty brass condenser tubes have been progressively reduced by the use of (a) bell-mouthed tubes; (b) replaceable ferrules; (c) carefully-fitted bushes, easily withdrawn and replaced, covering the inlet end of the tube for some inches; and (d) brass vanes inserted in the condenser, in positions determined by a mapping method.—P. R.

[Reply to the Discussion on] \*Some of the Factors Which Influence the Rates of Dissolution of Gold and Silver in Cyanide Solutions. E. Beyers (*J. Chem. Met. Min. Soc. S. Africa*, 1937, 37, (10), 524-526).—See *Met. Abs.*, this vol., p. 47.—S. G.

Calcium Chloride Corrosion of Plated Automotive Parts Can and Should Be Reduced. Edwin M. Baker and Howard R. Wilson (*Monthly Rev. Amer. Electroplaters' Soc.*, 1937, 24, (6), 451-467).—Addition of 0.25% of sodium bichromate to calcium chloride used as an anti-freeze inhibits corrosion of the nickel- and chromium-plated steel parts of motor cars.—A. R. P.

The Corrosion of the Tinplate Container by Food Products. T. P. Hoar (*Metallurgist* (Suppt. to *Engineer*), 1937, 11, 30-31).—A review of two reports by Morris and Bryan published in *Dept. Sci. Indust. Res. Rep. Food Invest. Board* for 1928 and onwards, and in *Dept. Sci. Indust. Res. Food Invest.*



*Special Rep.*, 1931, 40, (*Met. Abs. (J. Inst. Metals)*, 1931, 47, 315), and 1936, 44 (*Met. Abs.*, this vol., p. 98).—R. G.

\*The Corrosion of Tin in Nearly Neutral Solutions. T. P. Hoar (*Trans. Faraday Soc.*, 1937, 33, (9), 1152-1167; and *Tech. Publ. Internat. Tin Res. Develop. Council, Series A.*, 1937, (63), 16 pp.).—The rate of corrosion of tin by numerous alkali salt solutions, and by various chloride solutions, was studied by electrochemical measurements. On immersion in the medium, the natural oxide film is repaired by the formation of anodic oxide within its pores; when, however, the anodic metal at the base of the pores becomes sufficiently polarized, owing to lack of hydroxyl ion, enough soluble stannous ion may be formed there to cause breakdown of the film, and the production of a black spot. These black spots are formed by all solutions containing an anion the stannous salt of which is soluble, but not by those containing an anion yielding an insoluble salt, e.g. phosphate, borate, chromate, &c., since in this case undermining of the film cannot occur. Chloride solutions produce the most rapid breakdown, and their activity in this respect increases with increasing concentration. The black spots grow more rapidly in solutions of ammonium, magnesium, zinc, and calcium chlorides than in solutions of alkali chlorides. The rate of oxidation of freshly-abraded tin is very rapid at first, but becomes very slow after 6 hrs.—A. R. P.

\*Bitumen and Zinc. H. Walther (*Vedag-Buch*, 1936, 136-143; *Brit. Chem. Abs.*, 1937, [B], 62).—Zinc plates were coated with various types of bitumen and with coal-tar pitch, untreated strips being left at the top and bottom of each plate. The plates were exposed in an inclined position to the weather for 3 months, and the corrosive effects of the atmosphere (top strip) and of rain-water after washing over the coating (bottom strip) were compared. The alteration in the appearance of the coatings was also noted. In general, blown bitumens were much more corrosive than was either high-vacuum bitumen or pitch.—S. G.

†On the Scaling of Metals and Alloys [at High Temperatures]. Erich Scheil (*Z. Metallkunde*, 1937, 29, (7), 209-214).—Recent work on the formation of oxide layers on metals and alloys during prolonged heating at high temperatures is summarized, and the laws governing the thickening of the layer are explained. The oxide film thickens by diffusion of metal through the layer already formed, new layers of oxide forming on the outside of those already formed. If the oxide layer becomes loosened, i.e. if scaling occurs, then a new layer begins to form on the metal surface; by periodic scaling the rate of oxidation of the metal becomes linear. In the oxidation of alloys, the various constituents oxidize in an order closely approximating to the decreasing order of the heats of formation of their oxides; generally the oxides of the minor constituents concentrate at the boundary between metal and scale, irrespective of whether the metals are more or less noble than the major constituent. When the oxide or oxides of the minor constituent or constituents form a dense, adherent, non-porous scale on the alloy surface, so that the major constituent cannot diffuse outwards, then the alloy will be "non-scaling" or heat-resistant; this is the case with nickel-chromium- and chromium-aluminium-iron alloys such as are used for furnace windings.

—A. R. P.

\*Corrosion Tests of Some Metals and Alloys by a Higher Fatty Acid at 330°-340° C. Kiichiro Kino (*Kōgyō Kwagaku Zasshi (J. Soc. Chem. Ind. Japan)*, 1937, 40, (9)).—[In Japanese, with English abstract in supplemental binding, p. 312B.] Numerous studies have been made of the corrosion of metals and alloys by lower fatty acids, such as acetic, formic, propionic, and butyric acids, but K. has found few references to corrosion by higher fatty acids, especially at high temperatures. In this investigation the corrosion by stearic acid at 330°-340° C. was studied in the cases of: aluminium, zinc,

nickel, lead, Duralumin, nickel-brass, wrought iron, steel, stainless steel, silicon-steel, copper, brass, cobalt, chromium, and tin. The purity of the aluminium ranged from commercial metal to 99.99, 99.93, 99.8, and > 99.5%. The alloys were compared as regards loss in weight. Nickel-brass, silicon-steel, and copper had a satisfactorily high resistance; nickel and chromium were next in order of resistance, which is regarded as sufficiently good. The other materials were readily attacked.—S. G.

†On the Behaviour of Metals in the Tanning and Leather Industry. Reports of Progress for 1932-1935. R. Lauffmann (*Korrosion u. Metallschutz*, 1937, 13, (3), 81-86).—Copper-nickel alloys are the most satisfactory for brine pickling baths, and resist the action of vegetable tanning liquors better than Nimol and aluminium alloys; brass is better than copper and phosphor-bronze for resisting vegetable tans, and resists solutions containing sulphur dioxide better than nickel and Monel metal. Fats used in impregnating leather are coloured green by contact with copper and brass, and become cloudy in contact with zinc, owing to the formation of zinc soaps. Organic acids in leather readily attack most alloys containing copper, but have no action on tin.—A. R. P.

On the Dilution of Mineral Lubricating Oils with Vegetable Oils. A. Balada (*Petroleum Z.*, 1937, 33, (38), 1-8).—A review is given of service and laboratory tests on the influence of certain vegetable oils on mineral lubricants. Any initial advantage in the case of high-speed engines, especially as regards rape oil, is shown to be more than counterbalanced by the rapid thickening and deterioration of the mixtures, and examples of seizing, forming of deposits, and corrosion are illustrated. Air Ministry tests on a variety of vegetable oils, alone and in conjunction with 3 types of mineral lubricant, are described and tabulated.—P. M. C. R.

\*The Influence of the Mean Stress of the Cycle on the Resistance of Metals to Corrosion-Fatigue. H. J. Gough and D. G. Sopwith (*J. Iron Steel Inst.*, 1937, 135, 293-313; discussion, 340-351; also (abridged) *Engineering*, 1937, 143, (3726), 673-674; *Iron Steel Ind.*, 1937, 10, (10), 413-417; and *Iron Coal Trades Rev.*, 1937, 134, (3609), 800-803).—See *Met. Abs.*, this vol., p. 193.—S. G.

\*Polarimetric Studies of Oxide Film Formation on Metals. A. B. Winterbottom (*Nature*, 1937, 140, (3539), 364-365).—The application of polarized light to an investigation of the growth of oxide films on reduced annealed surfaces of copper is described. The results obtained are in general agreement with those of other workers using different methods.—B. C.

Corrosion of Metals. André Leroy (*Bull. Soc. Ing. Soudeurs*, 1937, 8, (45), 2708-2729).—A review of electrolytic corrosion theory leads to a consideration of the effects of welding upon corrosion resistance. Welds in mild steel only are considered.—H. W. G. H.

Basic Principles of the Technique of Potential Measurements in Corrosion Research and Topochemical Investigations. Friedrich Müller (*Korrosion u. Metallschutz*, 1937, 13, (4/5), 109-114).—A review of recent literature, with bibliography.—A. R. P.

\*The Local Current Theory of Metal Potential. III.—The Potential of Different Metals in Solution in Iodine-Potassium Iodide Solutions. W. J. Müller and E. Löw (*Z. Elektrochem.*, 1937, 43, (8), 561-569).—(See W. J. Müller, *Monats., Chem.*, 1936, 68, 431; 69, 437.) A satisfactory method is described for calculating the metal potential by a simultaneous determination of the potential and balance effect (*Differenzeffect*) in the absence of oxidizing solution constituents, which have a depolarizing effect on the local cathodes. In the absence of such oxidizing substances, these factors singly have no value. According to the law of diffusion, the controlled depolarization current is greater than the hydrogen polarization current, owing to the oxidizing



agent, which must theoretically show an increase in the cover film polarization by an amount  $i_x \cdot W_n$  (local current  $\times$  pore-resistance). The inferences from this theory were confirmed by the solubility tests of metals by Van Name and his co-workers by potential measurements in iodine-potassium iodide solutions with different iodine concentrations. These tests showed further confirmation of the conception of the influencing of metal potentials by cover films.—A discussion follows.—J. H. W.

## V.—PROTECTION

(Continued from pp. 445-447.)

**Surface Protection of Light Metals.** A. Koppenhöfer (*Aluminium*, 1937, 19, (5), 315-318).—Methods of protecting from corrosion aluminium- and magnesium-base metals used in aircraft construction are reviewed briefly; the methods include anodic oxidation, cladding with a more resistant light alloy, lacquering, and alloying.—A. R. P.

**\*Protection of Light Alloys.** E. J. C. Marsh and E. Mills (*Aircraft Eng.*, 1937, 9, (98), 97-102).—Some results of corrosion tests of various light alloys are given. Anodic treatments are discussed, and some details are given of the M.B.V. process and of results of corrosion tests of treated samples. Two forms of chromate treatment for magnesium-rich alloys are described, and results are given of some corrosion tests on a magnesium-rich casting alloy.

—H. S.

**\*Influence of Copper on the Corrosion-Protective Properties of Oxide Films on Aluminium.** P. V. Nazarov and J. V. Kuznetzova (*Legkie Metalli (Light Metals)*, 1936, (12), 30-35).—[In Russian.] The influence of additions of 0.11 to 3.95% copper to electrolytically refined aluminium on the protective properties against corrosion of films obtained by maintaining the alloys for 5 hrs. in an atmosphere of water vapour at 130° C. was studied. Chemical resistance was determined by the evolution of hydrogen on immersion in 2N-hydrochloric acid. It was found that, irrespective of whether it was in the form of a solid solution in aluminium or as  $\text{CuAl}_2$ , a high copper content sharply reduced the protective properties of the oxide film—in proportion to the copper concentration.—D. N. S.

**\*Methods of Testing Anodically-Produced Oxide Films (Eloxal Films).** Hellmut Fischer (*Aluminium*, 1937, 19, (6), 358-366; discussion, 391-392).—The thickness of Eloxal films on aluminium can be measured under the microscope by polishing a transverse section of the metal embedded in Wood's metal, or by determining the loss in weight when the film is removed in dilute sulphuric acid containing antimony sulphate. If the film is impregnated with fats or waxes, these must first be removed by washing the specimen with benzene or trichlorethylene. The weight of oxide film can also be determined by volatilizing the metal as chloride in a stream of chlorine, and weighing the residue. The thickness of the film can also be measured by first colouring it with alizarin red, and then measuring it under the microscope. Hardness may be measured by the scratch or impression methods and wear-resistance by the method of Mauksch and Budiloff (see abstract below). Various tests for porosity and corrosion-resistance are described.—A. R. P.

**\*Wear Testing of Eloxal Films.** W. Mauksch and N. Budiloff (*Aluminium*, 1937, 19, (5), 298-302).—The test consists in rubbing a hard metal pencil under a standard load to and fro on the film, until the metal is exposed; the motor driving the pencil is then automatically cut out by means of a relay, which is brought into action when the metal pencil completes the circuit by touching the aluminium surface. The number of double journeys made by the pencil is a measure of the wear-resistance of the film. To compensate for variations in the pencil or film hardness, four pencils are used simultaneously,

and the average value taken. The values obtained for Eloxal films produced in various ways on aluminium, Duralumin, Hydronalium, Lantal, Legal, Pantal, KSS, and Wicromal are tabulated and discussed.—A. R. P.

**On the Use of Eloxal for Heat Exchange Apparatus.** L. Lux (*Aluminium*, 1937, 19, (5), 334-336).—Eloxal treatment of aluminium surfaces very considerably increases their value as heat radiators. The heat radiated in kg.-cal./m.<sup>2</sup>/hr./(<sup>o</sup> abs.)<sup>4</sup> from various surfaces at 200° C. in a direction perpendicular to the surface is for clean, hard-rolled aluminium sheet 0.34, for similar sheet bright-rolled 0.20, for Silumin castings with casting skin 1.60, and for pure aluminium with an Eloxal film 3.62; the theoretical black-body radiation is 4.70. Sand-blasting the surface before the Eloxal treatment results in a better radiation than is obtained by applying this treatment to bright-rolled sheet.—A. R. P.

**\*On the Composition of the M.B.V. Film and the Variation of Its Properties with Increasing Time of Immersion, by Heating, and by Ageing.** Werner Helling (*Aluminium*, 1937, 19, (6), 375-381; discussion, 394).—The oxide film produced by immersion of aluminium for 10 minutes at 90°-95° C. in a 6% solution of a 10 : 3 sodium carbonate-chromate mixture consisted of aluminium hydroxide 72.8, chromium hydroxide 24.5, sodium oxide 1.35, and silicon (partly as silica and partly as graphitic silicon) 1.0%. The thickness of the film increases somewhat irregularly with time of immersion from 1  $\mu$  in 10 minutes to 7  $\mu$  in 2 hrs.; at the same time, the film becomes rougher and more porous, and consequently acquires a greater adsorptive capacity for organic dyes and lacquers. On heating, the film loses weight as the hydroxides are converted into oxides, changes in colour from grey to greenish brown at 120° C., to yellowish green at 500° C., and to a dirty yellow at 600° C., acquires a greater adsorptive power for dyes and lacquers, and becomes more resistant to dissolution by acids and alkalis. Storage for several days at room temperature also increases its resistance to corrosion without, however, affecting the colour.—A. R. P.

**Electrolytic Metal Coatings on Aluminium and Aluminium Alloys by the "Elytal" Process.** H. Ginsberg (*Aluminium*, 1937, 19, (6), 381-384; discussion, 394-395).—The process consists in anodically filming the metal surface with oxide e.g. in an acid phosphate bath, and then partially removing the oxide film in an alkali bath, e.g. a brass-plating bath. In the second stage, a film of brass is built into the residual oxide skeleton and firmly anchored thereby to the metal. Nickel may be subsequently deposited on the brass film to a thickness 5-10 times as great as that of the first film. Practical hints for obtaining good adherence and wearing properties in the plate are given.—A. P.

**Anodic Treatment of Aluminium.** Henry A. Smith (*Monthly Rev. Amer. Electroplaters' Soc.*, 1937, 24, (3), 175-181).—The anodic oxidation of aluminium and methods of colouring the film are briefly described, and some properties of anodized aluminium are discussed.—A. R. P.

**Finishing and Corrosion-Protection of Aeroplane Constructions in U.S.A.** V. O. Kroenig and I. A. Bakuta (*Tekhnika Vozdushnogo Flota (Tech. Air Fleet)*, 1937, (1), 79-85).—[In Russian.] A brief report on materials collected during a journey to the U.S.A.—N. A.

**\*The Oxidation of Aluminium-Coated Copper Wires.** V. A. Plotnikov and Z. Demchenko (*Zapiski Institutu Khimii, Ukrain'ska Akademia Nauk (Mem. Inst. Chem. Acad. Sci. Ukrain S.S.R.)*, 1934, 1, 111-118; *C. Abs.*, 1935, 29, 2091).—[In Ukrainian.] An aluminium oxide coating, up to 0.03 mm. in thickness, was produced by electrolytic oxidation at 120 v. and 0.02-0.04 amp./cm.<sup>2</sup> at 25°-30° C., in a 3 to 4% oxalic acid solution. Preliminary etching of the wire with alkali improved the final insulating properties.—S. G.

**Observations on Cylinder-Bore Wear [Reduction of Wear by Anodizing and Tin-Plating of Aluminium Pistons].** Max M. Roensch (*S.A.E. Journal*, 1937, 40, (3), 89-96; discussion, 96-98).—The causes of cylinder-bore wear are



thought to be, in order of importance: (1) abrasion-wear, due to foreign particles in the oil film; (2) erosion-wear, due to metal contact between the pistons or rings and the cylinder bore; and (3) corrosion-chemical action on the cylinder wall. The abrasion is thought to result primarily from the dust coming into the engine from the intake system, and is reduced very considerably by improved air filtering. Design plays the largest part in the second type of wear, which, however, is much reduced by anodizing or tin-plating aluminium pistons. Corrosion is prevented by quick warming-up, large and positive oil supply, and correct oil characteristics.—H. W. G. H.

**Protection and Colouring of Zinc and Aluminium Surfaces by Means of Molybdenum Sesquioxide.** Hugo Krause (*Draht-Welt*, 1937, 30, (18), 211-213).—Electrodeposited molybdenum appears less suitable for coating metal surfaces than does the sesquioxide, which may alternatively be applied by dipping. Bath compositions for both processes, and for a variety of base materials and colourings, are recommended, with special reference to iridescent finishes. The influence of certain ingredients on colour, adhesion, and durability is discussed.—P. R.

**Coating of Iron by Immersion in Molten Aluminium.** M. M. Gratsiansky (*Zapiski Institutu Khemii, Ukrain'ska Akademia Nauk (Mem. Inst. Chem. Ukrain. Acad. Sci.)*, 1936, 3, 247-255; *Brit. Chem. Abs.*, 1937, [B], 43).—[In Ukrainian.] Iron articles are immersed in 1:2:0.15  $\text{AlCl}_3$ - $\text{NaCl}$ - $\text{CuCl}_2$  at 450°-500° C. for 1-2 minutes, and then in molten aluminium at 700°-720° C. for 20-40 seconds, when an adherent coating of aluminium, 0.1 mm. thick, is obtained. Sieves made of aluminium-plated iron gauze are as resistant to the corrosive action of fruit juices as are aluminium sieves. The use of aluminium-plated iron sheets in place of tinplate in the canning industry is recommended.—S. G.

**The Importance of Aluminium in the Protection of Iron from Corrosion.** Curt Marensky (*Draht-Welt*, 1937, 30, (35), 427-429; (36), 439-440; (37), 451-452).—Statistics are given which illustrate the rapid development in the world production of aluminium; a further rapid increase is probable as a result of the development of hot-coating processes analogous to tinning. The properties and composition of the "oxide" layer, to which the corrosion-resistance of aluminium is chiefly due, are discussed, and the application of aluminium to a ferrous base by rolling, spraying, Calorizing, Alitizing, and electrodeposition is briefly reviewed. Attempts to develop a hot-dipping process are briefly described; the principal causes of failure have been the liability of aluminium to oxidation, and the difficulty of securing satisfactory adhesion. A continuous process, due to Fink, is described in detail; the advantages claimed are examined critically, and possible developments are discussed.—P. R.

**Aluminium Coating Successfully Applied to Steel.** — (*Eng. and Min. J.*, 1937, 138, (9), 38).—An outline is given of the Fink process for coating steel with aluminium, in which the steel is subjected to the action of a reducing gas, such as hydrogen, before passing into the aluminium bath. The most favourable reducing temperature for steel strip is 732° C. The characteristics of aluminium-coated steel are referred to briefly.—R. Gr.

**Cladding of Aluminium with Aluminium in the Patent Literature.** E. Hermann (*Aluminium*, 1937, 19, (6), 419-427).—A review of German, Swiss, American, French, and English patents dealing with manufacture and joining of clad aluminium and its alloys.—A. R. P.

**Principles of Monel Metal- and Nickel-Clad Mild Steel Sheet; Its Working and Economic Importance for Use as Raw Material in Chemical Construction.** Rudolf Müller (*Chem. Apparatur*, 1937, 24, (1), 19-22; (4), 49-52).—A 10% cladding of nickel or Monel metal on mild steel saves one-ninth the weight as compared with plain steel of equal thickness, increases the resistance to chemical attack, and has little effect on the strength of the material from the constructional point of view. The manufacture, working, and welding of

the material is described. In welding, the steel side is cut into a vee, which is filled with steel, using a steel welding rod adapted to give non-porous deposits; the other side of the joint is then cut to a smaller vee, which is filled with Monel metal or nickel, and the surface then ground smooth.—A. R. P.

\***The Effect of Protective Coatings on the Corrosion-Fatigue Resistance of Steel.** D. G. Sopwith and H. J. Gough (*J. Iron Steel Inst.*, 1937, 135, 315-339; discussion, 340-351; also *Engineering*, 1937, 143, (3721), 533-535).—See *Met. Abs.*, this vol., p. 195.—S. G.

\***Surface Tension and Viscosity Phenomena in Tinsplate Manufacture.** Bruce Chalmers (*Trans. Faraday Soc.*, 1937, 33, (9), 1167-1176; and *Tech. Publ. Internat. Tin Res. Develop. Council, Series A*, 1937, (64), 10 pp.).—A mathematical study of the phenomena governing the tinning of steel indicates that, unless the effective radius of a non-reactive region is greater than about 0.7 of the local thickness of the tin coating, a normal pore cannot be formed. Similarly, it is shown that the movement of tin under gravity on the steel is very small after the metal has been distributed by the grease pot rolls. The effect of the grease film on the porosity of tinsplate is discussed, with reference to the surface tension and viscosity of the grease and the molten tin.—A. R. P.

**Some Defects in Tinplates.** C. Hopkins (*Swansea Tech. Coll. Met. Soc. Papers*, 1933, (Oct. 14), 17 pp.).—S. G.

\***On the Bearing Strength (Auflagestärke) and Bendability of Hot-Galvanized Sheet.** Heribert Grubitsch (*Z. Elektrochem.*, 1937, 43, (8), 557-558).—Read before the Deutsche Bunsen-Gesellschaft. To explain the relation between the bearing strength and bendability of hot-galvanized coatings and the immersion time and temperature, a large number of systematic immersion tests were undertaken. The results showed that the zinc coat is primarily dependent on the thickness of the alloy layer formed. The thickness of this alloy layer increases in the temperature range 430°-480° C. for equal immersion times, as a function of a power of  $e$ . For different immersion times, but equal temperatures, the thickness of the alloy layer, and therefore of the total coating, varies as the fourth root of the immersion time. The zinc coat attains a maximum at 480° C., and again diminishes rapidly at higher temperatures. The structure of the coat is closely dependent on the temperature. For the numerical value of the bendability, the reciprocal was selected, or that multiple of the sheet thickness that allows the sheet and coating to bend through 180°, when the first cracks on the coating are observed. The reciprocal bendability and bearing strength for equal times of immersion vary with the temperature. A stricter relationship between the bearing strength or thickness of the alloy layer and the bendability, independent of the time and temperature of immersion, has not yet been determined.—J. H. W.

**The Treatment of By-Products Formed in the Hot-Dip Galvanizing Process.** Wallace G. Imhoff (*Met. Ind. (N.Y.)*, 1937, 35, (6), 292-294).—Dross is best treated by shaking out the zinc on a vibrating screen at a temperature just above the melting point of zinc. Skimmings containing oxide and chlorides are leached to remove soluble salts, the residue of oxide and zinc shot is dried and ground in pebble mills fitted with a cyclone arrangement to blow out the fine oxide, and the resulting metal shot and scrap is liquated on a sloping hearth to recover zinc suitable for returning to the galvanizing pot.—A. R. P.

**The Use of Pure Zinc in Hot-Galvanizing.** John J. Enlow (*J. Amer. Zinc Inst.*, 1937, 18, 83-87; discussion, 87-88).—Compares, from a practical point of view, experience with Canadian zinc, having low lead and iron and no cadmium, and retort zinc used in the U.S.A. The former requires the addition of tin as spangling agent.—H. W. G. H.

**Workshop Galvanizing.** A. Eyles (*Machinist (Eur. Edn.)*, 1937, 81, (32), 439-440E).—Discusses the reasons for using zinc as a protection against rust, and describes some details of the hot-galvanizing process.—J. H. W.



**The Galvanizing of Wire.** C. A. Kellogg (*J. Amer. Zinc Inst.*, 1937, 18, 88-93; discussion, 93-95).—Practical details are given of the hot-dipping process used for farm fence wire. The process is continuous, the wire being passed through annealing baths of molten lead, air-cooled, cleaned in hot hydrochloric acid, rinsed, fluxed in zinc chloride solution, passed through the zinc bath, and wiped by asbestos.—H. W. G. H.

**New Electroplating Mill for Round Wire.** (Crane.) See p. 526.

**\*A Practical Trial of Roofing of Sheets of [Galvanized] Copper-Steels and Other Materials, with the Results as Regards Their Corrosion After a Period of Exposure of 9½ Years to Date.** (Sir) Robert Hadfield and S. A. Main (*J. Iron Steel Inst.*, 1937, 135, 81-85; discussion, 86-99).—See *Met. Abs.*, this vol., p. 195.—S. G.

**\*On the Reactions of Iron with Liquid Zinc.** (Scheil and Wurst.) See p. 503.

**Pickling of Iron Prior to Hot-Dip Galvanizing.** (Bablik.) See p. 556.

**Testing Bethanized Wire Coatings.** E. J. Crum (*Monthly Rev. Amer. Electroplaters' Soc.*, 1937, 24, (5), 370-373).—Total zinc coating is determined by stripping in hydrochloric acid containing 10% of antimony trichloride, uniformity of coating by the Preece test, and purity of the zinc coating by immersion in 5% sulphuric acid which does not attack the wire when the zinc is pure.—A. R. P.

**Theoretical Investigation of the Methods of Schoop Metal Spraying.** M. Schoop (*Russko-Germanskij Vestnik Nauki i Tehniki (Deut.-russ. Zeit. Wiss. Tech.)*, 1937, (2), 10-11).—[In Russian.] A short review.—N. A.

**\*Results of Tests [on Sprayed Metal Coatings].** — (*Métalliseur* 1937, (9), 5-10).—The first of two articles giving the results of tests on metal-sprayed coatings carried out by the Laboratoire du Comité des Recherches & Expériences Techniques des Peintures & Vernis. Twenty-five test-pieces were prepared and coatings of zinc, pure aluminium, stadal, stainless steel, lead, cadmium, and Inalium were tested. The samples were submitted to 24-hr. cycles in a special corrosion-testing machine, in which the conditions are designed to bring about the effects of an industrial atmosphere. Some of the test-pieces were sprayed by the wire process and some by the powder process. Results are given of test-pieces No. 1 to 9; they show, in general, the long life which may be expected from metal-sprayed coatings. Some of the coatings were left as sprayed, and others were treated in various ways.—W. E. B.

**Aluminium-Magnesium Metal-Sprayed Coatings on Other Metals.** W. Erdmann (*Aluminium*, 1937, 19, (6), 385-387; discussion, 397-398).—Hydronalium wire is recommended for use in Schoop spray pistols for producing light metal coatings on motor accessories, household utensils, &c. It can also be used for providing Elektron with a more corrosion-resistant coating.—A. R. P.

**Metallizing or Sprayed Zinc.** William C. Reid (*J. Amer. Zinc Inst.*, 1937, 18, 65-70; discussion, 70-73).—The improvements in metallizing equipment are emphasized, fourfold increase in spraying speed since 1931 being claimed. Among the many applications described, are: large fabricated structures, such as bridges, lock gates, boat hulls, mine cars, water storage tanks, outdoor conveyor rolls; transport tanks for pure glycerine, carbon tetrachloride, and aviation spirit; reflecting surfaces on glass (replacing Al on account of cheapness); zinc coatings on wood insulator pins to dissipate static charges; wooden foundry patterns and core boxes; decorative effects on plaster, &c.; and walls and piping of cold storage rooms.—H. W. G. H.

**Corrosion Protection [by Sprayed Zinc Coatings].** — (*Imperial Smelting Corpn.*, 1937, 31 pp.).—Illustrates typical applications of sprayed zinc coatings, and gives a brief description of their properties and of the operation of the Schoop pistol.—J. C. C.

**Some Advice on the Installation of a Metal-Spraying Workshop.** Jacques Cauchetier (*Métalliseur*, 1937, (9), 1-4).—Discusses the lighting of cabinets used for metal spraying, and gives suggestions for exhausting chambers for the settling of dusts set up in the process.—W. E. B.

**Maintenance with the Metallizing Process.** R. A. Axline (*Metallizer*, 1937, 5, (10), 2, 3, 6).—A brief description of the improvements in apparatus technique of the metal-spraying process during recent years. A tin coating has been found preferable to either aluminium or zinc for cast-iron heater tanks used in the paper industry. A list is given of the uses of metal spraying in paper mills, including the spraying of bronze on paper driers and steel rolls. Lead is recommended for pipe fittings, valve tees and elbows. A description is given of a job where copper spraying was used, with success, to make a large copper tank water-tight.—W. E. B.

**Metallization of a Dam Gate at Almaville.** — (*Soudeur-Coupeur*, 1937, 16, (5), 21-23).—The gate, which is illustrated and described, was coated with Monel metal after sand-blasting.—H. W. G. H.

**Production Methods at the Parker-Wolverine Company.** H. F. Reves (*Metal Cleaning and Finishing*, 1937, 9, (5), 364-371; (6), 503-506).—A detailed account is given of the three main plants of the Parker-Wolverine Co. The equipment available for metal finishing of any sort (except porcelain enamelling) is described and illustrated, whilst the processes of Bonderizing, Parkerizing, japanning, wood graining on metal, lacquering, and various types of production plating are briefly discussed.—I. J.

**Painting of Aluminium and Its Alloys.** W. Herbig (*Aluminium*, 1937, 19, (6), 371-374; discussion, 393-394).—The painting of aluminium with synthetic lacquers and varnishes, with and without previous anodic treatment, is discussed.—A. R. P.

**The Preparation of Metal Surfaces for Painting.** A. L. Jordan (*Chem. and Ind.*, 1937, 56, (16), 361-370).—A comprehensive review of the subject. In the section on the protection of iron and steel, coating by metal spraying, electroplating, and galvanizing are discussed, as well as pre-treatment, and new developments. The various surface treatments for aluminium and magnesium, and the development of impervious paint coatings, are described. References to ancient methods of protecting iron by phosphates, contributed by J. Newton Friend, are added.—R. G.

**On the Printing and Lacquering of Metal Strip.** Fritz Ohl (*Kalt-Walz-Welt* (Suppt. to *Draht-Welt*), 1937, (2), 9-12).—The hard, smooth, and non-absorbent surface of metal strip necessitates an entirely different printing technique from that employed with soft materials. The use of driers must be strictly controlled; colour cannot be successfully applied direct to the uncoated sheet; careful provision must be made for drying between successive applications; the machinery must be sufficiently robust, and difficulty may be experienced through the "running" of pigments on account of heat conducted by the strip. Adhesion is usually secured by varnish dressings, the composition of which is discussed. Pigments must be heat-resistant, and must be capable of being lacquered. A lacquering composition is recommended, and 3 machines, two of which are of the sprayer type, are illustrated.—P. R.

**Lacquered Wire; New Lacquers; the Testing of Lacquered Wire.** Fritz Ohl (*Draht-Welt*, 1937, 30, (33), 403-405; (34), 415-416).—Lacquered wire is of increasing importance in various branches of the electrical industry. The selection of lacquers, driers, and solvents is discussed, and the relative merits of lacquer, cotton, and silk as insulating materials are considered. The qualities tested should include appearance, surface finish, electrical resistance, resistance to chemical attack, uniformity of dimensions, liability to kink and snap, elasticity of coating, and ordinary mechanical properties. The methods adopted by an important industrial laboratory are described.—P. R.



**The Uses of Lacquers in the Metal Industries.** Gustave Klinkenstein (*Met. Ind. (N.Y.)*, 1937, 35, (4), 170-173).—The various types of lacquers now on the market are briefly described, and the multitudinous effects producible by their use on metals are illustrated.—A. R. P.

**The Application of Lacquers to Metal Products.** Gustave Klinkenstein (*Met. Ind. (N.Y.)*, 1937, 35, (5), 230-233).—Dipping machines, spray-guns, rotary sprayers, roller coating machines, centrifuges for removing excess of lacquer, and drying ovens are described and illustrated.—A. R. P.

**Coatings of Artificial Resins for Electric Cables.** E. Pallas (*Korrosion u. Metallschutz*, 1937, 13, (3), 95-97).—Various types of artificial resins for coating lead cable are described, as well as methods of applying them, and their value as insulation and as protection against corrosion is discussed.—A. R. P.

## VI.—ELECTRODEPOSITION

(Continued from pp. 447-451.)

**A New Process for the Electroplating of Aluminium and Aluminium Alloys.** J. Korpiun (*Chem. Apparatur*, 1937, 24, (13), 217-218).—The article is given a preliminary etch in a zincate bath containing certain heavy metal salts (nature not stated), which act as inhibitors and prevent pitting of the aluminium, while producing a smooth thin zinc coating without spoiling the reflectivity of brilliantly polished surfaces; after rinsing, the articles can be given a copper flash in a cyanide bath, and then finished with nickel or chromium or both. The resulting deposits are non-porous, bright, and flexible; with 0.029 mm. of nickel plate, the aluminium remains unattacked after 12 days' immersion in 10% potassium hydroxide solution at 20° C.—A. R. P.

**\*The Electrodeposition of Sheet Chromium.** R. H. Roberts (*J. Electrodepositors' Tech. Soc.*, 1937, 12, 111-112).—See *Met. Abs.*, this vol., p. 51.—S. G.

**Laminated Chromium Plating.** R. J. Piersol (*Metal Cleaning and Finishing*, 1937, 9, (3), 209-214).—The development of internal stresses in chromium plate is prevented, and thick deposits may be built up, by plating at a high current density and intermittently breaking the current or removing the article from the bath for 30-60 seconds after every 0.2-0.4 mil. of deposit is formed. The resulting deposits are extremely hard, so that the method may be used, e.g. for producing a hard bright finish on steel rolls used for cold-rolling of sheet iron to a mirror finish.—A. R. P.

**Industrial or "Hard" Chromium Plating.** D. A. Nemser and W. E. Bancroft (*Metals Handbook (Amer. Soc. Metals)*, 1936, 821-824).—The properties of the deposits, and the plating method, &c., are briefly discussed.—S. G.

**Relation of Chromium to Other Plating.** R. J. Piersol (*Products Finishing*, 1937, 1, (11), 32-36; *C. Abs.*, 1937, 31, 6974).—The historical development of chromium plating, reasons for its commercialization since 1923, and the nature of the commercial process of chromium plating are reviewed.—S. G.

**Testing and Stripping of Electrodeposits. V.—Chromium.** B. Egeberg and N. E. Promisel (*Metal Cleaning and Finishing*, 1937, 9, (9), 731-737).—Chromium is best stripped from copper alloys, nickel, or steel by means of cold 1:1 or hot 1:9 hydrochloric acid containing an inhibitor (usually antimony chloride) if the base metal is nickel or steel. Anodic stripping in concentrated sulphuric acid is best for zinc-base metals and for aluminium-base metals 65% sulphuric acid containing 5% of glycerin. Thickness may be determined by stripping chromium plate (on copper or nickel undercoats) in 1:1 hydrochloric acid at 32° C., 0.00005 in. of plate being removed in 1 minute, and gassing ceasing when the nickel or copper is exposed.—A. R. P.

**Chromium Salts: Safety Precautions for Chemical Plant Operatives.** C. H. S. Tupholme (*Indust. and Eng. Chem., News Edn.*, 1937, 15, (19), 433).—Discusses the hazards in the use of chromium salts in industry, and lists precautions which should be taken by those who have to work with them.—S. G.

**Testing and Stripping of Electrodeposits. II.—Gold.** B. Egeberg and N. E. Promisel (*Metal Cleaning and Finishing*, 1937, 9, (3), 185-190).—Plated deposits of gold on nickel or high nickel alloys may be stripped by anodic dissolution in sodium cyanide solution, using a cathode current density of more than 20 amp./ft.<sup>2</sup> to prevent dissolution of the nickel by making it passive; the loss in weight after stripping is calculated to gm./in.<sup>2</sup>. The same method may be used to strip pure gold from silver, copper, and their alloys, but, since these metals also dissolve in cyanide, the gold content of the solution and of any deposit on the iron cathode must be determined analytically; this method must be used in the case of alloy plates or rolled gold, although in the case of rolled gold the weight of casing may sometimes be determined directly by weighing the residue after the base metal is dissolved in nitric acid.—A. P.

**Electrodeposited Lead for the Protection of Iron and Steel.** F. W. Hay (*Metallurgist* (Suppt. to *Engineer*), 1937, 11, 23).—A brief discussion of the advantages of protection of steel by a cold electrodeposited lead coating.—R. G.

**The Nickel-Plating of Steel Wire and Strip.** Eugen Werner (*Draht-Welt*, 1937, 30, (19), 223-224; (20), 236-238).—The plating of fine wire, especially in fabricated form, is discussed with special reference to preparation and bath concentrations. Similar data are given for strip; in this latter case the concentration must be maintained throughout (necessitating careful selection of anodes). In both types of work plating must be uninterrupted.—P. R.

**\*Some Factors Governing the Ductility of Nickel Electrodeposits.** E. A. Anderson (*Monthly Rev. Amer. Electroplaters' Soc.*, 1937, 24, (5), 340-349).—Carbon dioxide in amounts exceeding 4 c.c. per litre of nickel plating bath causes edge-cracking of the deposits. Exposure to the ordinary atmosphere results in absorption of only 0.4 c.c. of carbon dioxide per litre, which is well below the danger limit, but, if the solution is used cold and air is bubbled through to ensure agitation, a dangerous concentration of the gas may be built up; continuous exposure of carbon dioxide-saturated solution to air without agitation for several days results in equilibrium concentration of 0.4 c.c. per litre being regained. Addition of acid, vigorous agitation with pure air, or boiling the solution will also reduce the carbon dioxide content. It is suggested that the effect of carbon dioxide is due to its reduction to carbon monoxide at the cathode, since treatment of the solution with this gas produces hard, brittle, and cracked deposits. The results of some preliminary work on the orientation of nickel deposits produced on zinc under different conditions are recorded.—A. R. P.

**\*The Effect of Nickel Chloride in Nickel-Plating Solutions.** M. Waite (*Monthly Rev. Amer. Electroplaters' Soc.*, 1937, 24, (3), 183-188; discussion, 188-192).—Two solutions were made up, both 0.5N in boric acid and 2.5N in nickel, but one made from nickel sulphate and the other of nickel chloride; plating tests were then carried out, using mixtures of the two solutions in various proportions. The  $p_H$  required to produce a cathode efficiency of 99% decreased, as the chloride concentration was increased from 0.05 to 2.5N, from 3.03 to 1.91 at 40° C., and from 3.16 to 1.74 at 60° C. The Brinell hardness of deposits made at 40° C. increased with chloride concentration from 123 at 0.2-0.4N to 77 at 2.5N; the corresponding hardnesses of deposits made at 60° C. were 102 and 194. As the deposits become harder, the grain-size becomes smaller, but there is a greater tendency to roughness and nodule formation, and frequently the colour becomes darker.—A. R. P.

**Bright Nickel-Plating.** O. J. Sizelove (*Monthly Rev. Amer. Electroplaters' Soc.*, 1937, 24, (3), 193-198).—Brief notes on the use of cadmium additions to nickel baths to produce bright plates.—A. R. P.



\*The Structure of Electrodeposited Nickel. (Finch and Williams.) See p. 510.

Testing [Nickel-Plating Solutions] with  $p_{\text{H}}$  Papers. T. H. Chamberlain (*Met. Ind. (N.Y.)*, 1937, 35, (6), 279-280).—The use of paper strips for determining the  $p_{\text{H}}$  of nickel-plating baths is described.—A. R. P.

Solution of Nickel Anodes. Eugen Werner (*Metallbörse*, 1934, 24, (92), 1466-1467; (94), 1498-1499).—The relative solubilities of the different types of nickel anodes—cast, rolled, hammered, sintered, and electrolytic—are discussed.—S. G.

Testing and Stripping of Electrodeposits. III.—Nickel, Cobalt, and Nickel-Cobalt. B. Egeberg and N. E. Promisel (*Metal Cleaning and Finishing*, 1937, 9, (5), 375-382; (6), 493-497; erratum, 497).—The most important function that nickel deposits may serve is that of corrosion protection, which has been shown to primarily depend on the thickness of deposit. Detailed accounts are given of the methods available, both physical and chemical, for the identification of a plating and of the basis metal, for the determination of weight and average thickness of deposit, stripping from defective work for the purpose of replating, testing for local thickness, &c. The authors have attempted to sift the mass of data on nickel deposits, and give only the most satisfactory methods for a given purpose. Whilst most of the determinations are carried out either by progressive chemical attack or electrolytically, it is difficult definitely to establish the presence of a thin nickel plate on top of a high nickel basis metal. In such a case, it is recommended that microscopic examination be made at high power. E. and P. stress the importance of adhesion tests for nickel and cobalt plating, and several methods of testing this are described, all of which are semi-quantitative in nature. Standard methods of testing platings for hardness, wear-resistance, and porosity are outlined. Most of the tests described are accelerated ones, and do give useful information if carefully interpreted.—I. J.

\*Nickel-Cobalt Alloy Plating from Low  $p_{\text{H}}$  Acid Sulphate Solutions. C. B. F. Young and Charles Egerman (*Electrochem. Soc. Preprint*, 1937, (Oct.), 377-388).—The codeposition of nickel-cobalt alloy from a strong acid sulphate solution was studied with the aid of a rotating cathode. The effect of agitation, current density, temperature, H-ion concentration, and of an addition agent was determined. It was found that: (1) increasing the agitation resulted in an increase in the cobalt content of the deposited nickel-cobalt alloy; (2) increasing the current density decreased the cobalt content of the alloy deposit; (3) increasing the temperature caused an increase in the cobalt content of the deposit; (4) increasing the H-ion concentration resulted in an increased cobalt content of the deposited alloy; and (5) the presence of an addition agent as a brightener did not affect the composition of the deposit.—S. G.

Metal Finishing Economics.—Silver-Plating. Herbert R. Simonds (*Iron Age*, 1937, 140, (9), 38-43).—Discusses the economics of silver-plating "flat ware," i.e. knives, forks, and spoons other than carving sets, the historical background of nickel silver, and the use of other base metals for plated ware, the technique of silver-plating, control of baths, and final finishing.—J. H. W.

\*The Electrodeposition of Tin. II.—Anode Maintenance of an Alkaline Stannate Bath. Lawrence E. Stout and Albert H. Baum (*Electrochem. Soc. (Preprint)*, 1937, (Oct.), 201-216).—There are two main difficulties in the electrodeposition of tin from alkaline stannate baths. The tin content of the bath is depleted by precipitation of meta-stannic acid and by unbalanced electrode efficiencies. The former is excessive at low sodium hydroxide concentrations, but is reduced by operating the bath at higher alkalinities. This high sodium hydroxide content, however, tends to produce spongy cathode deposits unless other precautions are taken. The relative rate of anode corrosion may be varied by increasing the anode to cathode ratio and by anodic polarization. This polarization is attained by increasing the anode

current density to a critical value at which the tank voltage suddenly increases, and a green anode film develops. The value of this critical anode current density depends on the sodium hydroxide content in excess of that formed by the hydrolysis of sodium stannate. It has been demonstrated that with proper attention to these factors tin-plating baths can operate for long periods of time and maintain a constant tin content from anode corrosion and without the use of oxidizing agents (sodium perborate or hydrogen peroxide) in the plating bath.—S. G.

**\*Plating of Zinc from Ammonium Sulphate Zinc Baths.** Raymond R. Rogers (*Metal Cleaning and Finishing*, 1937, 9, (4), 277-280, 288).—The effects of varying the content of ammonia, sulphuric acid, and ammonium sulphate, and of varying the current density and temperature of baths containing 100 gm. (ammoniacal) or 250 gm. (acid) of zinc sulphate per litre on the appearance of the deposits obtained was investigated. The best results were obtained under the following conditions: (a) *ammoniacal bath*:  $\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$  100,  $\text{NH}_4\text{OH}$  173,  $(\text{NH}_4)_2\text{SO}_4$  94 gm./litre, current density 28 amp./ft.<sup>2</sup>, temperature 40° C.; (b) *acid-bath*:  $\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$  250,  $\text{H}_2\text{SO}_4$  123 gm./litre, current density 150 amp./ft.<sup>2</sup>, temperature 27° C.—A. R. P.

**New Electroplating Mill for Round Wire.** C. C. Crano (*Met. Ind. (N.Y.)*, 1937, 35, (5), 221-223).—A large American installation, producing 578 miles of heavily zinc-plated steel wire per day, is described; the tank is 140 ft. long, 6 ft. wide, and 2 ft. deep, holds 43,000 gall. of special bright plating solution, and is coupled with filters, settling tanks, and a cooling tower. The anodes, in the form of 30 tons of zinc slabs, are laid at the bottom of the bath, and 40 steel wires are passed through in parallel at the rate of 35-70 ft./minute, according to the thickness of coating required; the current density is 1500 amp./ft.<sup>2</sup>, and the deposits are bright, smooth, and free from pores.—A. R. P.

**The Plating of Zinc Alloy Die-Castings and Rolled Zinc.** E. A. Anderson, C. E. Reinhard, and W. W. Kittleberger (*Metal Cleaning and Finishing*, 1937, 9, (9), 721-726, 755-756; and *Met. Ind. (Lond.)*, 1937, 51, (16), 389-392; (17), 413-416).—From a booklet published by the New Jersey Zinc Co. Details are given of methods of cleaning the work, composition of suitable plating solutions (nickel and copper), and optimum working conditions.—A. P.

**Galvanic Deposits on Aluminium and Aluminium Alloys.** K. Altmannberger (*Light Metals Rev.*, 1937, 3, (14), 323-324).—Summary from *Metallwirtschaft*, 1937, 16, (7), 161; see *Met. Abs.*, this vol., p. 154.—L. A. O.

**Plating of Unusual Materials.** S. Fischer, Jr. (*Monthly Rev. Amer. Electroplaters' Soc.*, 1937, 24, (5), 365-369).—Various colour effects may be obtained on metals treated anodically in alkali vanadate, molybdate, and tungstate solutions; if the deposits are made on tungsten or molybdenum wires which are then heated, an adherent oxide film, resistant to scaling at high temperatures, is said to be produced. Some information is also given on the anodic deposition of rubber on metals.—A. R. P.

**Stripping Metal Deposits.** Nathaniel Hall (*Met. Ind. (N.Y.)*, 1937, 35, (5), 223-224; (6), 283-284).—Methods of removing nickel, chromium, cadmium, tin, and zinc deposits from steel, brass, copper, nickel silver, nickel, and aluminium are briefly described.—A. R. P.

**Significance of Anode and Cathode Efficiencies [in Plating].** C. B. F. Young (*Steel*, 1934, 95, (21), 38, 51).—S. G.

**What Importance Has  $p_H$  for the Metal Ware Industry?** A. Kufferath (*Metallwaren-Ind. u. Galvano-Tech.*, 1937, 35, (19), 399-401).—Instruments for the colorimetric and electrometric determination of  $p_H$  in plating baths are described and illustrated.—A. R. P.

**The  $p_H$  of Alkaline Electroplating Solutions.** Richard Springer (*Met. Ind. (N.Y.)*, 1937, 35, (4), 174-175).—Cyanide brass-plating solutions work well at  $p_H$  9.8-10.2, yield spotty deposits at  $p_H$  10.3-11.0, olive-green deposits at  $p_H$



11-12, and red deposits at  $p_H$  12.5-13.5. Cadmium cyanide-plating baths work best at  $p_H$  12-13; at higher or lower  $p_H$  the deposit tends to peel. The optimum  $p_H$  for copper cyanide-plating baths is 10.7-11, for zinc cyanide baths above 13, for hot alkaline tin baths 13-13.5, and for alkaline cleaner baths above 13.5.—A. R. P.

**Electrodeposition of Metals.** John K. Anthony (*Metals Handbook (Amer. Soc. Metals)*, 1936, 899-900).—Very brief. Gives the compositions of various plating baths for copper, nickel brass, nickel-cobalt, zinc, chromium, cadmium, tin, and iron.—S. G.

**New Method of Measuring Plated and Polished Surfaces [Profilometer].** S. Bousky and E. J. Abbott (*Metal Cleaning and Finishing*, 1937, 9, (5), 425-428, 432).—Describes the application of the Profilometer, a new instrument, to measure the heights of surface irregularities of from 2 to 20 micro inches. Its success in allied industries indicates that it will soon play an important part in solving plating problems. By means of this instrument it has been shown that buffing of nickel reduces its roughness by  $\frac{1}{10}$ , but that chromium plating on this surface is from 5 to 7 times as rough as on unbuffed nickel.—I. J.

**Improving the Electroplating Circuit.** J. H. Hoefler (*Metal Cleaning and Finishing*, 1937, 9, (7), 567-570, 582; and *Met. Ind. (Lond.)*, 1937, 51, (10), 235-237).—Read before the Anderson Branch, American Electroplaters' Society. Difficulties in the operation of any electroplating unit are often traceable to faulty conditions in the electroplating circuit. The importance of the electrical phase of plating is discussed. Too much time should not be devoted to the chemical and metallurgical aspects of the subject.—I. J.

**Slimes in Electrolytic Baths and their Elimination.** R. Tiquet (*Galvano*, 1936, (55), 21-24; and *Metal Cleaning and Finishing*, 1937, 9, (6), 507-510).—The origin, disadvantages, and methods of removal of insoluble suspended matter in electroplating baths, are discussed. Much of the roughness of surface and impurities in platings can be attributed to the projection (by electrophoresis) of slime or solid particles in suspension in the baths, upon the plating.—I. J.

**Drag-Out.** Gustaf Soderberg (*Monthly Rev. Amer. Electroplaters' Soc.*, 1937, 24, (3), 156-165; discussion, 165-174).—The importance of minimizing drag-out losses in plating is emphasized, with reference to certain specific cases. Drag-out losses are reduced by allowing sufficient time for drainage, by providing proper racking and efficient drainage holes, and by maintaining a balanced anode-cathode efficiency.—A. R. P.

**Spotting Out.** Stanley Town (*Monthly Rev. Amer. Electroplaters' Soc.*, 1937, 24, (6), 468-469).—Practical hints for preventing spotting out on plated castings.—A. R. P.

**Films and Their Relation to Cleaning before Electroplating.** (Johnson.) See p. 556.

**Solvent Degreasing Prior to Electroplating.** (Blake.) See p. 556.

**Metal Rectifiers for Electroplating.** — (*Met. Ind. (N. Y.)*, 1937, 35, (6), 281-282).—The efficiency and economics of copper oxide rectifiers for supplying current to plating baths are discussed.—A. R. P.

**Gas Immersion Heating of Solution Tanks.** J. B. Nealey (*Metal Cleaning and Finishing*, 1937, 9, (3), 191-192).—The gas burner is clamped to the side of the tank in such a way as to fire through a coil welded in the side, and disposed inside the tank in a horizontal position a little above the floor. The walls and bottom of the tank must be insulated with about 3 in. of rock-wool or similar material. This method is more economical than steam-heating, and requires much less piping.—A. R. P.

**The Rubber-Lining of Tanks.** Haviland F. Reves (*Metal Cleaning and Finishing*, 1937, 9, (9), 788-790).—A brief description of the process, and of the uses of rubber-lined tanks in the plating industry.—A. R. P.

**A Review of the Electroplating Research at Indiana University.** Frank C. Mathers (*Monthly Rev. Amer. Electroplaters' Soc.*, 1937, 24, (5), 350-357).—A brief review of the work of M. and his collaborators on the effects of additions on the character of electroplates, and on plating with antimony, tellurium, magnesium, bismuth, lead, nickel, and silver; a *bibliography* of 23 references is appended.—A. R. P.

**An Electroplating Department for a Small Manufacturer.** Robert J. Green (*Met. Ind. (N.Y.)*, 1937, 35, (7), 344-346).—The lay-out of a small copper- and nickel-plating shop is described, with details of the plant and of the electrolytes.—A. R. P.

**American Practice in Electroplating.** George B. Hogaboom (*Monthly Rev. Amer. Electroplaters' Soc.*, 1937, 24, (6), 438, 440, 442-449).—See *Met. Abs.*, this vol., pp. 154, 400.—A. R. P.

## VII.—ELECTROMETALLURGY AND ELECTROCHEMISTRY

(Other than Electrodeposition.)

(Continued from pp. 451-453.)

†**Electrochemical and Electrometallurgical Industries.** J. W. Cuthbertson (*Rep. Prog. Applied Chem.*, 1936, 21, 385-416).—Progress during 1936 in electrolytic processes for the extraction, refining, plating, and surface-treatment of metals, in electrothermal processes and in secondary cells is reviewed in the concise and comprehensive manner familiar to readers of these reports. There are 113 *references*.—J. C. C.

\***The Theory of the Phenomenon of Electrolysis in Solid Metals.** Karl Schwarz (*Z. Elektrochem.*, 1937, 43, (8), 585-587).—Read before the Deutsche Bunsen-Gesellschaft. The theory of the mechanism of electrolysis in liquids has been successfully applied to solid alloys. This is justified on the grounds that even on those parts of the lattice on which a displacement of the lattice component occurs through electrolysis, an especially low degree of order exists, so that the similarity between the solid and the liquid is greater. It was shown that the ion with the greatest intensity of charge migrates to the cathode. The dimension of the transference number varies exactly as with the fluid alloys with the mobility or diffusion constant, and is less than  $\frac{1}{10}$  that of fluid alloys. A comparison of the few experimentally investigated cases—copper-gold, palladium-gold, iron-carbon—shows agreement between the calculated and observed directions of migration. The calculation leads to the hypothesis that in the cases of copper-gold and palladium-gold, both alloy components have the same valency. In the case of iron-carbon, the iron was assumed to be trivalent, and the carbon tetravalent. The quantitative agreement between the observed and calculated transference numbers is well within the limits of experimental error. In the system lead-gold, where the gold unexpectedly migrates to the anode, the gold must be assumed to be uncharged, which fact appears consonant with the other properties of this remarkable alloy. A short discussion follows.—J. H. W.

\***The Standard Voltaic Potential  $\Delta\psi_0$  of the Most Important Electrochemical Two-Phase Systems, Especially the Electrodes: Metal/Metal Salt Solution.** Otto Klein and Erich Lange (*Z. Elektrochem.*, 1937, 43, (8), 570-584).—Read before the Deutsche Bunsen-Gesellschaft. The external potential difference, the voltaic potential  $\Delta\psi$ , of certain two-phase systems has been determined. The direct measurement of  $\Delta\psi$  metal/metal<sup>+</sup>-salt solution is not easy, on account of the scarcely-avoidable contamination of the metal surface, and, hence, an indirect method was devised, depending on the



partly theoretical and partly experimental assumption that each o.m.f. is the sum of all the voltaic potentials,  $\Delta\psi$ , existing in the system. Thus, the absolute standard voltaic potential,  $\Delta\psi$  metal/metal<sup>+</sup>-salt solution has been determined for the most important electrochemical two-phase systems with an average accuracy of 0.1 v. With these values the course of the voltaic potential of galvanic cells can be indicated. The importance of the determined voltaic potential for the calculation of the absolute effective heat of hydration was shown. A short discussion follows.—J. H. W.

\*The Antimony Electrode in  $p_H$  Measurements. T. R. Ball (*Electrochem. Soc. Preprint*, 1937, (Oct.), 235-247).—The general theory of the antimony electrode is dealt with. Under very rigorously controlled conditions, the electrode functions according to the Nernst equation. The failure of the polished cast electrode to conform to theory is doubtless due to non-uniformity of the oxide coating. It is claimed by some investigators that the metal contains  $Sb_2O_4$  formed during casting, and also that surface air oxidation results in  $Sb_2O_3$ ,  $Sb_2O_5$  plus a peroxide of unknown composition. These factors affect the potential. Electrodes made of metal from 3 different sources showed no variation which could be attributed to the source. An empirical formula may be derived for the oxide electrode by which  $p_H$  values may be calculated. The accuracy is about  $\pm 0.06$  between  $p_H$  2 and 7. If the oxide coating is replaced by sulphide, the limit is extended to about  $p_H$  10 on the alkaline side and the variation between electrodes is decreased.—S. G.

\*The Standard State of Copper. A Study of the Copper-Cupric Electrode. Leon M. Adams and Denton J. Brown (*J. Amer. Chem. Soc.*, 1937, 59, (7), 1387-1388).—The factors involved in the preparation of the standard state of copper were studied. The crystals of copper that were grown slowly at 25° should be considered as the standard state, and the value of the normal electrode potential is 0.3472 v.—S. G.

\*The Effect of the Speed of Rotation on the Electrode Potentials of Copper and Zinc. Colin G. Fink and Henry B. Linford (*Electrochem. Soc. Preprint*, 1937, (Oct.), 147-155).—A quantitative study was made of the effect on the metal electrode on rotating the electrode at high speeds (8000 r.p.m.). As the speed of rotation increased, the potentials of the copper and the zinc became more noble—to as much as 9 to 15 mv., respectively, at 25° C. The magnitude of this change in potential depends on the ion concentration. The results are in agreement with the theory of Procopiu. Rotation brings about a change in the ion concentration in the liquid layers next to the electrode. A distinct increase in potential (becoming more noble) was observed whenever the motor rotating the cathode was suddenly stopped.—S. G.

Flow Potentials on Platinum (Preliminary Communication). H. R. Kruyt and J. Oosterman (*Proc. K. Akad. Wet. Amsterdam*, 1937, 40, (5), 404-406).—[In English.] Flow potentials occur if a liquid, flowing along a boundary, carries ions from the electric double layer occurring at the boundary. This phenomenon is studied, in the case of the flow of very carefully distilled water, through a platinum capillary. The results show that it is impossible to determine the electrokinetic potential of platinum by flow potential measurements.—J. S. G. T.

The Platinum Electrode. III.—Adsorbed Atoms and Ions on the Surface of a Platinum Electrode. A. Frumkin and A. Slygin (*Izvestia Akademia Nauk S.S.S.R. (Bull. Acad. Sci. U.R.S.S.)*, 1936, [Chim.], (5), 773-792).—[In Russian.] See abstract from periodical printed in English, *Met. Abs.*, this vol., p. 402.—S. G.

\*The Platinum Electrode. V.—The Measurement of the Capacity of a Smooth Platinum Electrode When Charged With Currents of Low Density. B. Ershler (*Acta Physicochimica U.R.S.S.*, 1937, 7, (3), 327-338).—[In English.] The anodic polarization of a smooth platinum electrode in various solutions,

*viz.* 1N-KBr + 0.03N-HCl; 1N-HCl; 1N-Na<sub>2</sub>SO<sub>4</sub> + 0.03N-HCl; 1N-KOH, at current densities of the order 10<sup>-7</sup> to 10<sup>-8</sup> amp./cm.<sup>2</sup>, is studied, and the results are discussed.—J. S. G. T.

**\*Electrode Potentials of Platinum, Gold and Silver in Various Solutions of Electrolytes.** I. M. Kolthoff and Chin Wang (*J. Physical Chem.*, 1937, 41, (4), 539-544).—Gold and platinum electrodes in solutions of copper sulphate and nitrate behave as air electrodes. The potential is not affected by the concentration of copper ions. After removal of air by nitrogen, the electrodes no longer behave as air electrodes. Apparently the oxidation potential of the copper solutions is measured. Gold and platinum electrodes in solutions of silver nitrate of a concentration > 0.01M indicate the oxidation potential of the silver solution ( $\text{Ag}^+ + e \rightleftharpoons \text{Ag}$ ). The potentials are not affected, or only very slightly, by a change of the H-ion concentration or by removal of oxygen by nitrogen. In all cases the noble metals are easily polarized, and the systems are not suitable for exact measurements.—S. G.

**The Standard Electrode Potential of Silver.** J. J. Lingane and W. D. Larson (*J. Amer. Chem. Soc.*, 1936, 58, (12), 2647-2648).—A method of calculating the standard electrode potential of silver from a thermodynamic equation connecting the required value with the standard potential of the silver-silver chloride electrode and the activity product of silver chloride, is based on quantitative data due to Carmody and to Brown and MacInnes. The discrepancy between the value for silver found by Lewis and Randall and that given in the International Critical Tables, attributable to the revised standard potential value for the calomel electrode, is thus obviated.—P. R.

**\*Fused Salt Batteries with Eutectic Alloy Electrodes.** V. A. Plotnikov, N. S. Fortunatov, and N. N. Gratzianskii (*Zapiski Institutu Khimii, Ukrain'ska Akademia Nauk (Mem. Inst. Chem., Ukrain. Acad. Sci.)*, 1934, 4, 1099-1101; *C. Abs.*, 1935, 29, 2095).—[In Ukrainian.] Voltaic cells using metals or alloys and fused salts were made up as follows: Cd | CdCl<sub>2</sub> or CdSO<sub>4</sub> | alloy of bismuth, tin, lead; Al | AlCl<sub>3</sub>, NaCl | Cu; Bi | CdCl<sub>2</sub> | Cd; and Zn | ZnSO<sub>4</sub> | Cu (at 100° C.). After a short operation at low temperature, the e.m.f. of the first 3 cells decreases to zero, and it is found that a eutectic alloy has deposited on the nobler metal. On working at temperatures above the melting point of the eutectic alloy, the e.m.f. also decreases at first, but does not reach zero because of the melting away of the eutectic film.—S. G.

**\*Reduction Potentials of Tervalent Earths.** W. Noddack and A. Brukl (*Angew. Chem.*, 1937, 50, (20), 362-365).—Current potential curves obtained by the dropping mercury cathode method are shown for 0.01M solutions of rare earth sulphates; all curves show two points of inflexion, one due to reduction to the bivalent stage, and the other to amalgam formation. The potential difference between the two points is a measure of the stability of the bivalent sulphates; this decreases in the order: europium, ytterbium, samarium. The values for scandium and gadolinium are only slightly smaller than for samarium, and it should be possible, therefore, to obtain bivalent compounds of these metals. The electrical work required to discharge ions to form amalgamated atoms decreases linearly with increase in atomic number from lanthanum to neodymium and from terbium to lutecium; the values for the intermediate group samarium, europium, and gadolinium are approximately the same, and yttrium gives the same value as holmium.—A. R. P.

**Polarization Accompanying the Precipitation of Alkali Metals at a Mercury Cathode.** O. Essin, M. Loschkarev, and K. Sofiysky (*Acta Physicochimica U.R.S.S.*, 1937, 7, (3), 433-450).—[In German.] The current density-potential curves characterizing the precipitation of Na<sup>+</sup> and K<sup>+</sup> ions at a mercury "strahl" electrode, or a similar amalgam electrode from aqueous solutions of the chlorides and hydrates of the corresponding metals are studied. It is found that the polarization,  $\pi$ , is given in terms of the current density,  $D$ ,



by the relation  $\pi = -0.058 \log(1 + D/K_1)$ , where  $K_1$  is proportional to the initial concentration of the amalgam and to the velocity of efflux of the "strahl" electrode.—J. S. G. T.

**\*The Formation of Metallic Bridges in Separated Contacts.** G. L. Pearson (*Phys. Rev.*, 1937, [ii], 51, (11), 1015).—Brief abstract of a paper read before the American Physical Society. Low-resistance bridges were formed between gold, steel, and carbon electrodes having separations of  $2-70 \times 10^{-6}$  cm., by applying voltages less than the minimum sparking potential. For a given pair of electrodes, the field required to form the bridges is a constant and is  $5-16 \times 10^6$  v. per cm. Measurements of the temperature coeff. of resistance of the bridges identify them as consisting of the material of the electrodes. A study of their resistance as a function of the displacement of one of the electrodes shows that they may be pulled out as well as crushed. At voltages less than those required to form bridges, field currents exist. These increase rapidly as the field is increased, and attain a value of about  $10^{-10}$  amp. before the bridges are formed. Calculation of the maximum electrostatic stress on the electrodes at the time of the breakdown gives a value 0.05 to 0.0005 times the tensile strength of the electrode material at room temperature. The field is locally higher than that calculated, because of surface roughness, and the tensile strength is probably decreased by the local heating known to accompany field currents. The data indicate, therefore, that electrostatic force pulls material from the electrodes to bridge the gap.—S. G.

**The Development of Applied Electrochemistry.** G. Pistor (*Z. Elektrochem.*, 1936, 42, (7b), 434-438).—L. A. O.

## IX.—ANALYSIS

(Continued from pp. 453-458.)

**On the Application of Spectrographic Methods to the Analysis of Metals.** S. L. Mandelstam (*Zavodskaja Laboratoria (Works' Lab.)*, 1937, 6, (1), 55-65).—[In Russian.] Spectrographic methods for the analysis of Fe and non-ferrous metals and alloys are reviewed.—D. N. S.

**Spectroscopy in the Metal Industries.** Kevin Burns (*Instruments*, 1937, 10, (5), 129-132).—Typical spectrographs are reproduced illustrating the detection of Cd in commercial Zn alloys, the use of enclosed arcs in He to eliminate air lines, the use of an interferometer in conjunction with a glass prism spectrometer to separate the Ga from the Mn line at 4034 Å., and the applications of a grating instrument for the examination of special steels. A grating is more convenient than a quartz spectroscope for wave-lengths longer than 2400 Å. in estimating such many-lined spectra as those of W and the rare earths. A glass spectroscope is convenient for the alkali elements.—J. C. C.

**Spectroscopic Analysis.** N. S. Bayliss (*Soc. Chem. Ind. Victoria [Proc.]*, 1936, 36, (6/9), 1182-1194).—A lecture describing the technique, apparatus, and uses of spectroscopic analysis with special reference to its industrial applications.—A. R. P.

**Spectrographic Analysis.** Charles C. Nitchie (*Metals Handbook (Amer. Soc. Metals)*, 1936, 58-69).—A review.—S. G.

**Contribution to Quantitative Spectrographic Analysis.** E. Badum and K. Leilich (*Angew. Chem.*, 1937, 50, (15), 279-282).—Covers essentially the same ground as Cruse (see following abstract).—A. R. P.

**Quantitative Emission Spectrographic Analysis.** Kurt Cruse (*Angew. Chem.*, 1937, 50, (22), 397-400).—The possible sources of error in the spectrographic analysis of alloys due to the nature and structure of the metal, the electrical conditions, and the photographic films used are discussed. The distance apart of the electrodes and variations in the potential on the primary

side of the transformer may cause appreciable differences in the blackness of the lines; these difficulties may be overcome by controlling the spark intensity by means of a photoelectric cell which is coupled with a device for altering the distance between the electrodes to obtain a discharge of constant intensity.

—A. R. P.

**\*Chemical Analysis by X-Rays.—I.** P. L. de la Cierva and L. Rivoir (*Anales soc. españ. fis quim.*, 1936, **34**, 770-778; *C. Abs.*, 1937, **31**, 6575).—Conditions which give the maximum sensitivity in chemical analysis by X-rays are studied. This method will show the presence of  $10^{-6}$  gm. of Ni in a brilliant, electrodeposited Zn. A method is proposed, based on the sensitivity coeff. of a photographic plate, which allows the determination of the correction due to the plate used in quantitative chemical analysis by the use of X-rays. Using these conditions, the method is applied to the determination of Mn in steel.—S. G.

**Use of Cupferron in Spectral Analysis.** Oskar Baudisch (*Arkiv Kemi, Min., Geol.*, 1936, [B], **12**, (8), 6 pp.; *Brit. Chem. Abs.*, 1937, [A], 46).—Fe, Cu, and Ti are quantitatively separated from other elements by one precipitation with cupferron from acid solutions. Cu is removed from the precipitate by digestion with aqueous  $\text{NH}_3$ . Dissolution of the precipitate in concentrated HCl, followed by precipitation of Fe with  $\text{H}_2\text{S}$ , affords quantitative separation from Ti, which may be reprecipitated with cupferron. All separations are spectroscopically quantitative.—S. G.

**\*Absorption Step-Weakensers of Antimony.** G. O. Longstroth and D. R. McRae (*Canad. J. Research*, 1937, [A], **15**, (9), 154-160).—It is of advantage to the spectroscopic analyst to have a means of quickly preparing a step-weakener of any required characteristics. A method has been developed in which Sb films are deposited by thermal decomposition of the trihydride. The apparatus required is simple, and a multi-step weakener may be made in 20 minutes. The films are nearly neutral below  $\lambda$  4000 Å. Their optical density is quite uniform, and they are sufficiently strong for all practical purposes. For high precision work, the construction of the weakener must be such that undesirable interference effects are avoided. A consideration of the theory of interference phenomena in light transmitted through thin plates suggests several possible methods of construction. Some of these have been adopted, and have been found to be satisfactory in practice.—S. G.

**Use of Copper Electrodes in Electro-Analysis.** A. B. Schakeldian and F. K. Fischer (*Abh. Staatsuniv. Saratov*, 1936, [ii], *Chem.*, **1**, 83-91; *Brit. Chem. Abs.*, 1937, [A], 98).—Pt cathodes may be replaced by Cu cathodes in the determination of Cu, Zn, Cd, and Ni.—S. G.

**Potentiometric Volumetric Analysis with Three Pairs of Electrodes in Series.** L. Szebellédy and J. Jónás (*Z. anal. Chem.*, 1936, **104**, (7/8), 271-278).—The titration vessel has 3 pairs of electrodes recessed into the side and coupled together in series; in this way the sensitivity is increased by 200%.—A. R. P.

**\*A Study of the Magneto-Optic Method of Analysis.** Donald C. Bond (*J. Amer. Chem. Soc.*, 1937, **59**, (3), 439-444).—S. G.

**Photometric Methods of Analyzing Aluminium Alloys.** H. Pinsl (*Aluminium*, 1937, **19**, (7), 439-446).—Photometric methods of determining Si (as silicomolybdate), Fe (as thiocyanate), Mn (as  $\text{KMnO}_4$ ), and Cu (in ammoniacal solution) in Al alloys are described in detail. Accurate results can be obtained in relatively short time.—A. R. P.

**\*Analysis of Copper-Nickel-Aluminium Alloy with the Aid of Organic Reagents.** A. M. Zanko and A. Ya. Bursuk (*Ber. Inst. physikal. Chem., Akad. Wiss. Ukrain. S.S.R.*, 1936, **6**, 245-246; *C. Abs.*, 1937, **31**, 6579).—Dissolve a 0.5 gm. sample in 15 c.c.  $\text{HNO}_3$  (1:1), evaporate to a syrupy state, wet with  $\text{H}_2\text{SO}_4$ , heat to fumes of  $\text{H}_2\text{SO}_4$ , cool, dissolve the residue in hot water, neutralize with a few drops of  $\text{NH}_3$ , add 10 c.c. of 2N- $\text{H}_2\text{SO}_4$ ,



and electrolyze to get Cu. Heat the solution to boiling, add 3 grm. tartaric acid, 15–20 c.c. of 1% alcoholic solution of dimethylglyoxime, and enough  $\text{NH}_3$  to make alkaline. Filter, wash the precipitate with hot water, dry at  $110^\circ$ – $120^\circ$  C., and weigh. Dilute the filtrate to 300 c.c., withdraw 100 c.c., and add to it 2 grm. tartaric acid, 5 grm.  $\text{NH}_4\text{Cl}$ , and enough  $\text{NH}_3$  to colour phenolphthalein. Then, while shaking, add in drops 20 c.c. of 2% acetic solution 8-hydroxyquinoline. Heat for  $\frac{1}{2}$  hr., filter, wash the precipitate with hot water until free from Cl ions, dry, ignite at  $1000^\circ$  C., and weigh as  $\text{Al}_2\text{O}_3$ .—S. G.

**A New Simple Method of Identifying and Separating the Cations of the Second [Analytical] Group.** Eugen Chirnoagă (*Z. anal. Chem.*, 1936, 104, (9/10), 356–358).—As is extracted from the  $\text{H}_2\text{S}$  precipitate by digestion with ammoniacal  $(\text{NH}_4)_2\text{CO}_3$  solution, Bi, Cd, Sn, and Sb by digestion with hot 2N-HCl containing  $\text{H}_2\text{O}_2$ , and Cu and Hg by boiling with conc. HCl and  $\text{H}_2\text{O}_2$ . Cd is isolated from the second solution by addition of  $\text{NH}_4\text{OH}$ , which precipitates all the other metals; these are identified in the usual way.—A. R. P.

**\*A New Fluorescent Test for Aluminium.** C. E. White and C. S. Lowe (*Indust. and Eng. Chem. (Analyt. Edn.)*, 1937, 9, (9), 430–431).—Al solutions give, with “Pontachrome Blue Black R,” a compound which gives an orange-red fluorescence when the solution is irradiated with ultra-violet light; the test will detect 0.2 p.p.m. of Al and is unaffected by the presence of Be.—A. P.

**\*Microchemical Reaction for Copper, Using  $(\text{NH}_4)_2\text{Hg}(\text{CNS})_4$ .** I. M. Korenman and E. N. Lukasheva (*Zavodskaja Laboratoria (Works' Lab.)*, 1936, 5, (12), 1438–1440).—[In Russian.] The sensitivity of the microchemical test for Cu is increased by the presence in solution of  $\text{Zn}^{++}$ ,  $\text{Cd}^{++}$ ,  $\text{Ni}^{++}$  and  $\text{Pb}^{++}$ , which form characteristically coloured mixed crystals in the presence of small amounts of Cu.  $\text{Zn}^{++}$  and  $\text{Cd}^{++}$  are particularly suitable, as they form with  $\text{Cu}^{++}$  violet-coloured crystals of the type:  $(\text{Zn,Cu})\text{Hg}(\text{CNS})_4$ . The Cu must first be separated from the metals which do not give amines, and, after the addition of 1–2 drops of a 20%  $\text{ZnSO}_4$  or  $\text{CdSO}_4$  solution, the mixed salt is precipitated by adding 1–2 drops of  $(\text{NH}_4)_2\text{Hg}(\text{CNS})_4$ . In the presence of  $\text{Cd}^{++}$  it is possible to detect 0.05  $\gamma$   $\text{Cu}^{++}$ , with a Cu : Cd ratio of 1 : 60,000. In the absence of  $\text{Zn}^{++}$  or  $\text{Cd}^{++}$ , the sensitivity is 0.3–1.25  $\gamma$  Cu, provided that the Cu : Co and Cu : Ag ratios do not exceed 1 : 30 and 1 : 16, respectively.—D. N. S.

**“Dithizone” an Excellent Reagent for Lead.** C. Franklin Miller (*Chemist-Analyst*, 1937, 26, (3), 55).—Diphenylthiocarbazono (“dithizone”) in 0.01%  $\text{CCl}_4$  solution yields bright red flakes at the interface of the two liquids when shaken with a dilute aqueous solution of a Pb salt; of the common metals only Sn, Tl, and large amounts of Bi and Cd interfere. The preparation of the reagent is described.—A. R. P.

**\*A New Qualitative Test for Selenium.**—I. H. A. Ljung (*Indust. and Eng. Chem. (Analyt. Edn.)*, 1937, 9, (7), 328–330).—As little as 0.05 p.p.m. of Se in HCl solution gives a distinct reaction when boiled with  $\text{NH}_4\text{CNS}$ , which reduces  $\text{SeO}_2$  to Se; the colour varies from pinkish white through bluish red to deep red according to the Se concentration.—A. R. P.

**\*Studies on the Quantitative Separation of Metals by Hydrogen Sulphide.** IX.—The Quantitative Separation of Cadmium from Zinc. Hisaji Katō (*Nippon Kwagaku Kwaishi (J. Chem. Soc. Japan)*, 1937, 58, (6), 598–604; *C. Abs.*, 1937, 31, 6577).—[In Japanese.] It is pointed out that perfect separation of CdS from ZnS is impossible in HCl solution. The separation can be carried out in  $\text{H}_2\text{SO}_4$  solution of 3.5–4.0N.—S. G.

**\*A Rapid Method for the Analysis of Refined Lead.** I.—A New Method of Determining Antimony. S. J. Fainberg (*Zavodskaja Laboratoria (Works' Lab.)*, 1937, 6, (1), 36–40).—[In Russian.] The Pb (100 grm.) is stirred with 10 grm. of a 2 : 3 mixture of KOH and NaOH in an Fe crucible at  $350^\circ$  C. The Pb should be allowed to solidify as a rounded button by rapidly rotating the

crucible after removing the burner, and the molten alkali poured off into a porcelain dish and treated with  $N\text{-NaOH}$ . The solution is transferred to a measuring-flask, and the Sb determined colorimetrically by Evans' method if only a small amount is present, or volumetrically if it exceeds 0.01%.—D. N. S.

\*On the Determination of Bismuth in Brass, Copper, and Zinc. A. V. Kugel (*Zavodskaja Laboratoria (Works' Lab.)*, 1936, 5, (12), 1508).—[In Russian.] The standard colorimetric method for Bi is modified by precipitating the Bi with  $\text{NH}_4\text{OH}$  from the  $\text{HNO}_3$  solution of the metal. The accuracy is 0.0005%.—D. N. S.

\*The Determination of Bismuth as Phosphate. W. R. Schoeller and D. A. Lambie (*Analyst*, 1937, 62, (736), 533–537).—When the Bi is separated as  $\text{Bi}_2\text{S}_3$  and this is dissolved in  $\text{HNO}_3$  for precipitation as  $\text{BiPO}_4$ , errors are introduced by co-precipitation of a basic sulphate; this difficulty is overcome by precipitating the basic carbonate with  $\text{Na}_2\text{CO}_3$  after dissolving the sulphide in  $\text{HCl}$  with the aid of an oxidizing agent. The Bi is then dissolved in  $\text{HNO}_3$  and precipitated as  $\text{BiPO}_4$  by addition of  $(\text{NH}_4)_2\text{HPO}_4$ ; this procedure is the most accurate for the gravimetric determination of Bi.—A. P.

\*Volumetric Determination of Cadmium in the Presence of Zinc and Copper. Ya. Fialkov and V. Gorodisskii (*Zapiski Institutu Khemii, Ukrain's'ka Akademia Nauk (Mem. Inst. Chem., Ukrain. Acad. Sci.)*, 1934, 1, 61–69; *C. Abs.*, 1935, 29, 2112).—[In Ukrainian.] Cd is precipitated as carbonate by addition of cold, saturated  $(\text{NH}_4)_2\text{CO}_3$  neutral to thymolphthalein. The precipitate is filtered, washed, dissolved in standard 0.1M  $\text{H}_2\text{SO}_4$ , and titrated with  $\text{NaOH}$ . The error did not exceed  $\pm 0.3\%$ , even in the presence of saturated  $\text{ZnSO}_4$  and  $\text{CuSO}_4$  solutions.—S. G.

\*Determination of Cadmium in Zinc Concentrates and Metallic Zinc [by Internal Electrolysis]. J. J. Lurie and M. I. Troitskaia (*Zavodskaja Laboratoria (Works' Lab.)*, 1936, 5, (12), 1425–1428 (in Russian); and (in German) *Z. anal. Chem.*, 1936, 107, 34–41).—The Zn is dissolved in  $\text{HNO}_3$ , the solution treated with  $\text{NH}_4\text{OH}$  until the  $\text{Zn}(\text{OH})_2$  redissolves, and then with 2%  $\text{Na}_2\text{S}$  to precipitate the Cd, heavy metals and about 0.5 gm. of Zn, the precipitate collected, and, without washing, redissolved in 1:1  $\text{HNO}_3$ , and the solution evaporated with  $\text{H}_2\text{SO}_4$  to fumes. After removing Cu, Sb, Bi, Pb, Fe, Al, Mn, and As in the usual way, the  $p_{\text{H}}$  of the solution is adjusted to 5.2 by addition of  $\text{H}_2\text{SO}_4$ ,  $\text{CH}_3\cdot\text{CO}_2\text{H}$ , and  $\text{CH}_3\cdot\text{CO}_2\text{Na}$ , and the cadmium then separated by placing in the solution a Fischer Pt gauze to the centre of which is attached a Zn plate by means of a Cu wire. Very accurate results are obtained and the method is more rapid than the usual  $\text{H}_2\text{S}$  method.—D. N. S.

Determination of Copper in Copper-Nickel Alloys with Salicylaldoxime. Marian Chambers (*Chemist-Analyst*, 1937, 26, (3), 52).—Cupro-nickels and nickel silver alloys are dissolved in  $\text{HNO}_3$ , the solution is evaporated with  $\text{H}_2\text{SO}_4$  to expel  $\text{HNO}_3$ , 150 c.c. of water are added, any insoluble material is filtered off, and the solution is treated with 2 gm. of tartaric acid,  $\text{NH}_4\text{OH}$  to neutrality, 10 c.c. of  $\text{CH}_3\cdot\text{CO}_2\text{H}$  and a 1% solution of salicylaldoxime. After 30 minutes in the steam bath the Cu compound is collected in a glass crucible, washed with dilute  $\text{CH}_3\cdot\text{CO}_2\text{H}$ , and dried at  $105^\circ\text{C}$ . Fe, Hg, Ag, Zn, Cd, Sn, Pb, and Mn do not interfere, but Co and Ti must be absent.—A. P.

\*Determination of Copper in Metallic Nickel. J. J. Lurie and M. I. Troitskaia (*Zavodskaja Laboratoria (Works' Lab.)*, 1937, 6, (1), 33–35).—[In Russian.] The metal is dissolved in  $\text{HNO}_3$ , the solution neutralized with  $\text{NH}_4\text{OH}$  and re-acidified with  $\text{CH}_3\cdot\text{CO}_2\text{H}$ , and the Cu deposited by internal electrolysis, using a Fischer Pt gauze with a Pb plate fixed to its centre by means of a Cu wire. The Cu is completely deposited in 40 minutes at  $80^\circ\text{--}90^\circ\text{C}$ . If much Fe is present, Na tartrate is added to the electrolyte.—D. N. S.



**On the Determination and Detection of Gold by Means of Filter Paper Impregnated with Reducing Compounds.** Rodica N. Costeanu (*Z. anal. Chem.*, 1937, 104, (9/10), 351-355).—The alloy is boiled with  $\text{HNO}_3$  to extract base metals, and the residual metal is dissolved in *aqua regia* and the solution diluted to a known volume. One drop of this is placed on a filter paper impregnated with  $\text{NH}_2\text{OH}\cdot\text{HCl}$ ,  $\text{SnCl}_2$ , benzidine, hydroquinone, or the like, and the resulting purple spot compared with those produced by standard Au solutions. The method is useful for determining the carat of Au articles using only a few scrapings of metal.—A. R. P.

**\*Determination of Gold and Platinum and Detection of the Platinum Metals.** S. O. Thompson, F. E. Beamish, and M. Scott (*Indust. and Eng. Chem. (Analyt. Edn.)*, 1937, 9, (9), 420-422).—In feebly acid solutions of  $\text{H}_2\text{PtCl}_6$  dimethylglyoxime precipitates Pt as bronze-coloured crystals of  $\text{PtC}_8\text{H}_{14}\text{N}_4\text{O}_4$ , but about 1 mg. of metal/100 c.c. remains in solution; this may be recovered by evaporation. The precipitate does not ignite well and should therefore be heated with conc.  $\text{H}_2\text{SO}_4$  to convert it into Pt sponge, any Pt dissolved by the acid being precipitated by dilution and boiling with  $\text{H}\cdot\text{COONa}$ . Excess of HCl in the original solution leads to very low results. Au is completely precipitated as metal by boiling the feebly acid chloride solution with dimethylglyoxime for 30 minutes; the washed precipitate is ignited directly for weighing. Various tests for the presence of other metals of the Pt group are described.  $\text{Na}_2\text{OsO}_4$  gives a blue colour with pyrogallol and an orange colour with ephedrine;  $\text{CCl}_4$  extracts the orange-coloured compound from the aqueous layer.—A. R. P.

**\*Determination of Small Amounts of Iron in Mercury.** R. Kraus (*Angew. Chem.*, 1937, 50, (30), 597-599).—The metal (50 grm.) is dissolved in 70 c.c. of conc.  $\text{HNO}_3$  and 50 c.c. of conc. HCl are added, followed, after 15 minutes, by 30 grm. of  $\text{NH}_4\text{Cl}$  to destroy  $\text{Cl}_2$  and  $\text{NOCl}$ . A slight excess of  $\text{NH}_4\text{OH}$ , HCl until the solution is clear, and  $\text{NH}_4\text{OH}$  drop by drop until a white curdy Hg precipitate is obtained, are then added successively; the precipitate contains all the Fe which can then be determined by reduction and titration with  $\text{KMnO}_4$  or colorimetrically. If only a little Fe is present,  $\text{AlCl}_3$  is added as a collector before the second  $\text{NH}_4\text{OH}$  treatment.—A. R. P.

**Volumetric Determination of Lead in Screw Brass and Similar Alloys.** A. Meyer (*Tech. u. Ind. u. Schweiz. Chem.-Zeit.*, 1937, 20, (1), 39-40).—The alloy is dissolved in  $\text{HNO}_3$ , the solution diluted, just neutralized with  $\text{NH}_4\text{OH}$ , and treated with 10%  $\text{CrO}_3$  solution at  $80^\circ\text{C}$ . The precipitate of  $\text{PbCrO}_4$  is collected, washed, and dissolved in HCl and the  $\text{CrO}_4^{2-}$  determined iodometrically in the usual way.—A. R. P.

**On the Oxidimetric Determination of Molybdenum. I.—Vanadate Method.** Rudolf Lang and Stephen Gottlieb (*Z. anal. Chem.*, 1936, 104, (1/2), 1-16).—The neutral molybdate solution is treated with sufficient HCl to make the solution 15-20 volume-% in conc. HCl, the  $\text{Mo}^{\text{VI}}$  is reduced to  $\text{Mo}^{\text{V}}$  by addition of 0.2N- $\text{SnCl}_2$  until the brown colour no longer deepens, the excess of  $\text{SnCl}_2$  is removed with a solution of Br in KBr, and the excess of Br with 0.3N- $\text{NaAsO}_2$ ; NaF is added and the solution titrated with 0.1N- $\text{NH}_4\text{VO}_3$ , using diphenylaminesulphonic acid as internal indicator. If the original solution contains W the NaF is added before reduction with  $\text{SnCl}_2$ , and a small quantity of  $\text{CuCl}_2$  is added before the Br solution to catalyze the oxidation of  $\text{WO}_2$  by Br.—A. R. P.

**\*Volumetric Determination of Selenium. A Critical Study of the Norris and Fay Method.** W. C. Coleman and C. R. McCrosky (*Indust. and Eng. Chem. (Analyt. Edn.)*, 1937, 9, (9), 431-432).—The method depends on the reaction:  $4\text{Na}_2\text{S}_2\text{O}_3 + \text{H}_2\text{SeO}_3 + 4\text{HCl} = \text{Na}_2\text{S}_4\text{O}_6 + \text{Na}_2\text{SeS}_4\text{O}_6 + 4\text{NaCl} + 3\text{H}_2\text{O}$ . With some slight modifications in the original procedure of N. and F. (*Amer. Chem. J.*, 1896, 18, 705), results accurate to 0.1% may be obtained.—A. R. P.

\*The Phosphotungstate Method for Vanadium. Spectrophotometric Study. E. R. Wright [with M. G. Mellon] (*Indust. and Eng. Chem. (Analyt. Edn.)*, 1937, 9, (6), 251-254).—V gives when boiled in dilute  $H_2SO_4$ , HCl, or  $HNO_3$  solutions a yellow to brown colour (stable for 2 days) with a solution 0.025M in  $Na_2WO_4$ , 0.5M in  $H_3PO_4$ , 0.6N in  $HNO_3$ , HCl,  $H_2SO_4$ , or  $HClO_4$ . The use of the test for the colorimetric determination of V in steel is described in detail. —A. R. P.

\*Quantitative Electrodeposition of Zinc from Acid Citrate Solutions. R. Winchester and L. F. Yntema (*Indust. and Eng. Chem. (Analyt. Edn.)*, 1937, 9, (6), 254-256).—Deposition of Zn is complete in 1.5 hr. with 1 amp./dm.<sup>2</sup> when the  $ZnSO_4$  solution is made 0.0375M with citric acid and the  $p_H$  adjusted to 4-5. Sb, As, Bi, Cd, Co, Cu, Fe, Pb, Mn, Hg, Ni, and Ag must first be removed.—A. R. P.

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

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

(Continued from pp. 458-459.)

Micro-Photographical Methods. A. Kufferath (*Aircraft Eng.*, 1937, 9, (100), 162-164).—Brief, illustrated descriptions are given of the Vickers camera microscope, the Orthophot, and other instruments for microscopic examination of aircraft materials, and typical micrographs are reproduced.

—H. S.

\*A Simple Method of Stereoscopic Photomicrography. Shin'ichi Shimadzu (*Mem. Coll. Sci. Kyoto Imp. Univ.*, 1937, 20, (1), 1-2).—[In English.] Two photomicrographs are taken of the object in positions reached, the one from the other, by tilting the object through about 20°, i.e. at angles of tilt of about 10° on either side of the optical axis of the observing microscope; the photographs are simultaneously viewed in a stereoscope. A magnification of 600 can be employed.—J. S. G. T.

Temper Control [of Brass] Using the Comparison Microscope. — (*Met. Ind. (N.Y.)*, 1937, 35, (4), 181).—The microscope allows accurate comparison of the grain-size of annealed metals with a series of standard lacquered specimens. The preparation of the specimens is described.—A. R. P.

A Recording Instrument for the Measurement of the Variability of the Cross-Section of Thin Wire. K. Dahl and T. Kern (*Elektrotech. Z.*, 1936, 57, (49), 1423-1425).—The changes in the resistance of the wire whilst passing through mercury contacts are measured by means of a Wheatstone bridge, and recorded automatically. The accuracy of the method is  $\pm 0.1\%$  for wires of diameter greater than 10  $\mu$ .—B. Bl.

An Induction Pump for Liquid Mercury. E. S. Gilfillan, Jr., and S. M. MacNeille (*Rev. Sci. Instruments*, 1937, [N.S.], 8, (1), 28-34).—A description is given of an all-metal pump for circulating mercury, operating on the principle of a polyphase induction motor, whereby the mercury is dragged along by virtue of electric currents induced in it. Lifts > 1 metre and capacities > 50 c.c. per sec. have been realized.—J. S. G. T.

\*Some Uses of the Torque Magnetometer. H. J. Williams (*Rev. Sci. Instruments*, 1937, [N.S.], 8, (2), 56-60).—The history of torque measurement as an index of ferromagnetic anisotropy is outlined. A simple magnetometer for torque measurement is described. Its uses include the measurement of anisotropy constants, coercive force, complete magnetization curves for single directions, rotational hysteresis losses. With auxiliary ballistic measurements, residual inductions and demagnetizing factors can be determined.—J. S. G. T.

A Mask for Printing Laue Photographs. C. H. Dwight and H. Kersten (*Rev. Sci. Instruments*, 1937, 8, (4), 132-133).—The central portion of Laue



X-ray crystal photographs, made with a small distance from crystal to film, is usually over-exposed, and spots near this region do not appear on positives. A rotatory sector device for eliminating this defect in the production of positives is described.—J. S. G. T.

**X-Ray Cameras for Work at Low Temperatures.** E. E. Flint and V. P. Butuzov (*Zavodskaja Laboratoria (Works' Lab.)*, 1937, 6, (1), 91-95).—[In Russian.] The walls and the base of the camera are made of copper. The base plate has a side piece with three holes through which are fitted copper rods of different diameters, the ends of the rods being immersed in liquid carbon dioxide. Efficient heat insulation of the camera, and the use of copper rods of varying thickness immersed to any required depth in the Dewar flask enable the temperature to be regulated with an accuracy of  $\pm 1^\circ$  in the range of  $-10^\circ$  to  $-60^\circ$  C.—D. N. S.

**Measurement of Intensity of X-Ray Radiation by a Proportional Intensifier.** V. Veksler and B. Isaiev (*Dokladi Akademii Nauk S.S.S.R.* 1936, 3, (8), 369-370 (in Russian); and *Compt. rend. Acad. Sci. U.R.S.S.*, 1936, 3, (8), 369-370 (in English)).—It is proposed to use a high-pressure, non-independent discharge for measuring the intensity of X-rays. The apparatus, which consists of an aluminium cylinder filled with a mixture of krypton 85, and xenon 15% at 660 mm. pressure, enables, owing to its high sensitivity, all measurements of ionization currents to be made with the usual mirror galvanometer of  $2 \cdot 10^{-9}$  amp. sensitivity.—N. A.

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

(Continued from pp. 469-460.)

**The Relationship Between Mechanical Tests of Materials and Their Suitability for Specific Working Conditions.** N. P. Inglis (*Trans. North-East Coast Inst. Eng. Ship.*, 1936-1937, 53, 101-130; discussion, D45-62).—This paper, with its very valuable discussion, was prepared with a view to possible consideration by the Joint Committee on Materials and Testing. It refers solely to ferrous materials, but is of considerable general interest. The requirements commonly specified for steel forgings are considered, and it is pointed out that usually these only indicate the general quality of the material. Further information, derived from special tests or previous experience, is required by the designer. Emphasis is placed on the possibility that mechanical properties may deteriorate in service, and examples of the reduction in notched-bar impact value of certain alloy steels at  $350^\circ$  to  $450^\circ$  C., and of mild steels at low temperatures, are described in detail.—J. C. C.

**Mechanical Testing of Materials.** W. Mardy (*Machinist (Eur. Edn.)*, 1937, 80, (51), 739E).—Comments on a paper by Inglis (preceding abstract), and discusses the interpretation and limitations of the tensile test.—J. H. W.

**Literature on the Non-Destructive Testing of Materials.** Otto Vaupel (*Maschinenbau*, 1937, 16, (11/12), 320-321).—References are given to the most important recent articles on the X-ray, magnetic, and acoustic methods of testing materials.—v. G.

**\*Investigation of the Deep-Drawability of Metals.** H. Fournier (*Publ. sci. tech. Ministère Air (France)*, 1936, (44), 1-33; *Chem. Zentr.*, 1936, 107, (1), 1493; *C. Abs.*, 1937, 31, 6162).—Cf. *Met. Abs.*, 1936, 3, 699. The deep-drawability of various materials—steel of average carbon content, 18 : 8 steel, brass (67 : 33), aluminium, and magnesium—was studied by the K.W.I. method for the examination of iron, and the best experimental conditions were determined. The sensitivity of this method, and also that of Persoz and Erichsen, was tested on the same materials. Tensile tests were also carried out.

The influence of previous treatment of the material on the results of these tests was investigated. The results indicated that each of the methods was especially applicable in certain circumstances. The K.W.I. method is specially suited to the testing of materials under great tension, and for the detection of slight changes in the material, such as those due to increase in grain-size, corrosion, &c. The Persoz and Erichsen method is best suited to the testing of materials under slight tension, and for the investigation of deep-drawability in relation to previous treatment. None of the results of any of the tests stands in any simple definite relation to the breaking strength, and the approximate formulæ developed are applicable to only a few definite cases.—S. G.

**\*On the Practical Value of Certain Tests on Deep-Drawn Material.** Otto Andrieu (*Kalt-Walz-Welt* (Suppt. to *Draht-Welt*), 1937, (7), 45-48).—Pickled and normalized deep-drawn sheet of standard dimensions was classified by a practical test (4 successive deformations without intermediate annealing), and test-pieces cut from elsewhere on the same (90) specimens were subjected to bending, elongation, drawing (Schmid), and cupping (Erichsen) tests. The divergence between the results in any one test was least in the case of the Schmid drawing test, and greatest in the elongation values. The results of the Schmid tests corresponded most closely with the classification obtained by the "practical" method. The various classifications obtained, and the variation in individual results, are compared graphically.—P. R.

**Fundamental Equation of Plasticity and Its Application.** Masujiro Nakahara (*Trans. Soc. Mech. Eng. Japan*, 1937, 3, (11), 141-145).—[In Japanese, with English summary in foreign edition, pp. 29-30.] Relations are derived between: (1) the principal stresses and strains, and (2) the three principal strains in a plastically-deformed body. The theory developed is applied to the case of a cylinder plastically strained by being subjected to pressures and different temperatures both inside and outside.—J. S. G. T.

**\*The Photoelastic Film Method for Measuring Surface Stresses in Loaded Constructional Parts Without a Pattern.** G. Oppel (*Z.V.d.I.*, 1937, 81, (27), 803-804).—Stresses in metal parts of constructional work can be measured by coating the surface with a transparent foil or lacquer film; on elastic deformation the film becomes optically double-refracting.—v. G.

**Test Specimens.** R. L. Templin (*Metals Handbook* (Amer. Soc. Metals), 1936, 45-49).—Tensile, compression, shear, impact, bend, fatigue, and cupping test-pieces are briefly discussed.—S. G.

**\*The Development of a Machine for High-Speed Testing of Materials.** R. J. Lean and H. Quinney (*Proc. Inst. Mech. Eng.*, 1937, 135, 467-483).—A tensile testing machine is described in which the stress is applied suddenly, so that the specimen is subjected to an impact stress. The load is applied by a strong spring beam, which is previously deflected so that its internal energy is greater than that required for the fracture of the specimen. The spring is released suddenly so that it fractures the specimen and then vibrates. On measuring the amplitude of the resulting vibrations immediately after fracture, the energy of fracture can be obtained by ascertaining the difference between the initial energy stored in the spring and the remaining energy which causes the vibrations. Suitable extensometers record the deformation process, and the machine enables the following properties to be recorded: total energy or toughness; yield-point; plastic yield-point and ultimate breaking load on a stress-strain curve; ductility; and time for fracture of the specimen. The use of different types of test-piece is discussed, and some results are given for mild steel.—W. H. R.

**\*Combined Mirror and Lever Extensometer.** Miyabi Sugihara (*Mem. Coll. Sci. Kyoto Imp. Univ.*, 1937, 20, (1), 19-26).—[In English.] A combination of Martens' lever and mirror forms of extensometer (see Batson and Hyde, "Mechanical Testing," Vol. I, 114 and 115) is described. Two clips carrying



two small rotating mirrors are held by a spring on opposite sides of the test-piece. Levers are attached to two double knife-edges pivoted in shallow seats in the clips. The lower ends of the levers rotate the mirrors in opposite directions when the specimen is elongated; the rotations are measured by telescopes and scale. The magnification of extension is of the order 7000.

—J. S. G. T.

\***A Plane Bending Apparatus with Interferometer Strain Recorder for Metalurgical Investigations.** J. W. Cuthbertson (*J. Sci. Instruments*, 1937, 14, (8), 268–275; and *Tech. Publ. Internat. Tin Res. Develop. Council, Series A*, 1937, (60), 14 pp.).—Apparatus is described for the determination of the modulus of elasticity of Babbitt metals, and other soft metals or alloys with a small elastic range. The specimen is in the form of a small bar, subjected to bending stresses by a method of loading which avoids many possible errors. The deflection is measured by an improved form of interferometer. Two modifications of the instrument are described, one for room temperature, and the other for high temperatures. Typical stress-strain curves for some non-ferrous alloys are reproduced.—W. H.-R.

**Proof Stress.** A. J. Field. C. H. M. Jenkins (*Monthly J. Inst. Metals*, 1937, 4, (1), 3; (3), 149).—F. condemns the loose usage of the term “proof stress” (determined by measuring the deformation produced by a given stress) in substitution for “elastic limit” (determined by measuring the stress producing a given deformation). The latter term should be prefixed by the percentage amount of permanent set, e.g. “0.2% elastic limit.” J. points out that a committee of the British Engineering Standards Institution adopted the term “proof stress” in place of “yield-point” for non-ferrous alloys not showing the typical yield-point of mild steel.—G. V. R.

\***An Electrical Fatigue-Testing Machine for Conduction of Tests in Controlled Atmospheres.** A. B. Winterbottom (*Kgl. Norske Videnskab. Selskab, Forh.*, 1936, (9), 172–175; *C. Abs.*, 1937, 31, 6927).—[In English.] The apparatus described was specially designed for the study of “atmospheric effect” by the conduction of tests *in vacuo* or in controlled atmospheres, and for the study of the electrode potential of immersed or sprayed surfaces subjected to alternating stressing. Tests can either be carried out on bars supported at the nodes in a vacuum-tight chamber, or on cantilever test-pieces held in a rigid vice. The machine is of the specific strain type, resonant vibrations being excited by electromagnets energized from a thyatron inverter. The chamber used for enclosed tests is of nickel-plated brass, while the floor and cover are of non-magnetic 18 : 8 stainless steel, to which Jena Tempax glass windows are waxed. Standard cones in the end walls can be used for vacuum or gas connections, while the vibrations can be observed and measured with a low-power microscope, focussed through the window at the midpoint of the front wall. A  $\frac{1}{8}$ -in. steel ball cemented to the test-piece provides a bright point drawing out to a line when the test-piece vibrates, the length of which can be measured with an accuracy of about 0.02 mm. Drawings of the apparatus and electric circuit are given.—S. G.

\***Rotating Bending Fatigue Machine with Hard Loading Springs.** W. Späth (*Z.V.d.I.*, 1937, 81, (25), 710–712).—A testing machine, built on the Wöhler principle, is described, in which the load is applied by means of a spring instead of by weights; in this way the beginning of plastic deformation is readily recognized when the load is applied slowly.—v. G.

†**Fatigue Testing of Constructional Parts in Their Natural Size.** A. Thum and G. Bergmann (*Z.V.d.I.*, 1937, 81, (35), 1013–1018).—Methods of testing and measuring the fatigue limit under repeated impacts, alternate bending or alternate twisting of machine parts are described.—v. G.

\***A New Tension-Compression Alternating [Testing] Machine.** Tosio Nishihara (*Trans. Soc. Mech. Eng. Japan*, 1937, 3, (11), 153–156).—[In Japanese,

with German summary in foreign edition, pp. 31-33.] The disadvantages (briefly referred to) associated with the testing machines designed by Haigh and by Schenck are removed in a machine designed by N., which is entirely mechanical, and not electrical, in action. Stress measurements can be readily made in this machine, which can be constructed so as to have any desirable capacity, and so that the test-piece can be rotated at its end. A comparison of results obtained with the three types of machine shows that the resistance to alternating tension-compression stresses, determined in N.'s machine, is 22-27% less than the value found with the other two types.—J. S. G. T.

\*Experiments in Fatigue-Bending and Tension-Compression Testing.—III. G. Welter (*Wiadomości Instytutu Metalurgii i Metaloznawstwa (Warszawa)*, 1937, 4, (1), 30-39).—[In Polish, with German summary.] Experiments were carried out on soft steel specimens in the recently developed fatigue-testing machine (*Met. Abs.*, this vol., p. 109) to determine the influence of surface condition of the specimen on the origin of crack formation. Specimens scratched spirally and longitudinally with coarse emery paper were fractured in fatigue-bending and fatigue-tension-compression tests. The surface condition was found to exert a small influence only on the results of the latter tests, but in the fatigue-bending experiments the alternations of stress required to produce fracture were in the ratio 1 : 2.5 for the spirally and longitudinally scratched specimens respectively. The external appearance of the fracture surface was rugged in the case of specimens scratched longitudinally, but in those scratched spirally, the fracture was clean and followed the direction of scratching. It was further shown that the heating of specimens in fatigue-tension-compression experiments takes place in four distinct stages. The initial change in the specimen occurs without appreciable heat development; then follows a steep increase in temperature, a period of approximate temperature constancy, and, finally, just before fracture, a further short increase in temperature. After the first stage, the tensile strength of the specimen is somewhat increased, and the yield-point on the stress-strain diagram is no longer clearly defined. By microscopic examination after subsequent cold deformation by tension, it was shown that the surface of the specimen remains unchanged until shortly before fracture, when a change occurs which is apparent on the extended specimen as numerous shallow rents in the surface. In spite of this change, the tensile strength of the specimen remains unaltered, so that the interior of the specimen must still be solid in spite of the numerous cracks in its surface. On the basis of these results, three new testing methods are proposed and examined, utilizing the measurement of temperature changes in the specimen and the observation of changes in the surface of highly polished specimens after relatively short stressing. The use of specimens of varying diameter is introduced to facilitate testing by the latter method.—P. W. R.

\*Experiments on Plastic Deformation of Aluminium and Copper Using a Modified Apparatus. G. Welter and T. Riedel (*Wiadomości Instytutu Metalurgii i Metaloznawstwa (Warszawa)*, 1937, 4, (1), 40-43).—[In Polish, with German summary.] A fatigue testing apparatus is described, which was developed from data in the literature and somewhat improved. In particular, the suspension of the sample is improved by means of a universally adjustable device which makes possible a perfectly axial loading. The results obtained with this machine on drawn copper and soft aluminium over a period of 7 days are recorded, and the performance of the machine is thereby shown to be satisfactory.—P. W. R.

Some Remarks on the Influence of the Rate of Loading on Tensile Tests. W. Späth (*Aluminium*, 1937, 19, (5), 312-315).—It is shown mathematically that the assumption of an internal frictional resistance to explain the plastic phenomena in loaded metals requires amplification. Better agreement with the observed behaviour of metals in the tensile test is obtained by considering



the total deformation under a given load as the geometrical sum of two separate deformations.—A. R. P.

\*†**Impact Testing from a Physical Standpoint.** R. V. Southwell (*Manchester Assoc. Eng. Advance Copy, 1937, (Oct.), 1-14*).—Impact tests carried out with the "Oxford" machine are compared with Izod and Charpy tests. The Oxford machine is of the ballistic pendulum type. Izod and Oxford figures are proportional over a wide range. S. suggests that the purpose of an impact test is to measure the resistance of a material to fracture as contrasted with plastic distortion. Dimensional theory and the "scale effect" in notched specimens are discussed briefly in explanation of the phenomenon that large specimens are found to be more "brittle" than small ones. Geometrical similarity in test-pieces does not extend to grain-size; the larger of two test-pieces of the same material has *relatively* the finer microstructure; it therefore behaves as though more "brittle." A more fundamental explanation suggests that geometrical similarity does not extend to the limiting range of action of cohesive forces. A *bibliography* of 7 references is appended.—J. T.

\*†**Some Aspects of the Notched-Bar Test.** L. W. Schuster (*Manchester Assoc. Eng. Advance Copy, 1937, (Oct.), 15-54*).—Briefly discusses: functions of the test (it is regarded as of great practical value as a *specification* test); repeated-blow impact test; dimensional effect with geometrically similar and dissimilar specimens; effect of width of the test-piece; the mechanism of failure; standard round specimens; form of notch; transition from crystalline to fibrous fracture; velocity of test; tensile impact test; experimental verification of several features of the test. A *bibliography* of 61 references is appended.—J. S. G. T.

**The Development and Present Position of Continental Research on the Notched-Bar Impact Test.** Max Moser (*Manchester Assoc. Eng. Advance Copy, 1937, (Oct.), 55-75*).—The matter is discussed under three separate stages of development, *viz.*: (1) conditions necessitating the introduction of the test, (2) scientific development of the test, and (3) the development of a small standard test-specimen to replace the comparatively large Charpy test specimen. Of all the test-specimens, the Charpy one differentiated most clearly between the various kinds and conditions of steel; of the new test-specimens, the performance of the 10 × 10 × 55 mm. specimen with a 2 mm. round notch approached that of the Charpy specimen very closely. A test-piece with these dimensions, but with the notch deepened to 3 mm., was fixed on as the German standard test-specimen. This test-piece is, however, not suitable for testing very tough steels; a sharper notch having a root curvature of 0.5 mm. is required for these tests. Work in France, Italy, and Great Britain is briefly reviewed. Most countries are prepared to accept the French test-specimen, of dimensions 10 × 10 × 55 mm. with a notch carried to the centre, for international purposes.—J. S. G. T.

**Machine for New High Velocity Method of Impact Testing.** — (*Instruments, 1937, 10, (1), 11*).—A brief, illustrated, description of the Mann and Haskell impact testing machine for measuring the energy absorbed in fracturing specimens at velocities up to 500 ft./second.—J. C. C.

**Wear Testing.** Samuel J. Rosenberg (*Metal Progress, 1937, 32, (1), 65*).—The test for relative sliding wear proposed by R. B. Freeman and D. S. Clark (*Met. Abs.*, this vol., pp. 255 and 406) is criticized as not reproducing service conditions sufficiently closely, adequate discrimination not having been made between different types of wear.—P. R.

**Wear and Lubricant Tester.** — (*J. Sci. Instruments, 1937, 14, (8), 284-286*).—An apparatus, designed by R. L. Smith, is described in which a revolving steel ball, similar to that used in a Brinell test, wears an impression in the flat surface of a test-piece under controlled conditions of load, lubrication, &c. A

microscope is provided by which the worn impression or the bearing track of the ball can be measured without removing the test-piece from the machine.

—W. H. R.

**The Measurement of the Hardness of Metals and Alloys.** E. M. H. Lips (*Philips Tech. Rev.*, 1937, 2, (6), 177-181).—The Brinell, Rockwell, and Vickers methods of measuring hardness are described, and their advantages and disadvantages are outlined. A description is given of an instrument, designed in the Philips Laboratories, by which the hardness of alloy micro-constituents can be determined. Essentially, a load of 0.02 kg. is applied through a spring to a diamond of the same form as the Vickers. This is done by fixing the instrument, in place of an objective, to the tube of a microscope, and screwing the microscope stage and diamond towards each other, until the metal under test just presses the diamond sufficiently to apply the load of 0.02 kg. This is indicated by a built-in electrical signal arrangement. The diagonals of the diamond impression are measured in the usual way.—E. V. W.

**Hardness Testing at Elevated Temperatures.** Oscar E. Harder (*Metals Handbook (Amer. Soc. Metals)*, 1936, 42-44).—Briefly reviews the methods that have been used in hardness testing at elevated temperatures, and discusses the important factors involved, and the precautions to be taken, in making such tests. A bibliography of 18 references is appended.—S. G.

**Notes on Hardness Tests.** E. Skerry (*Aircraft Eng.*, 1937, 9, (101), 190).—The use of hardness tests on structural materials is discussed briefly.—H. S.

**\*Correct Lines for the Uniform Determination of Hardness.** W. Kuntze (*Tech. Zentr. prakt. Metallbearbeitung*, 1936, 46, (15/16), 575-576; (17/18), 659-662; and *Mitt. Material., Souderheft*, 29, 1936, 121-124).—Methods for measuring hardness employing a cone, sphere, or cylinder subjected to pressure to make the impression are critically examined. The cone is preferred, and a description is given of procedure, applicable throughout the whole range of hardness, employing a cone, or preferably a diamond or hard metal pyramid. The hardness is determined from the depth of the impression, and is read off from tables. The choice of load is perfectly arbitrary.—J. S. G. T.

**\*A Continuous Hardness Test: Periodic Hardness Fluctuations.** Edward G. Herbert (*Metallurgia*, 1937, 16, (95), 184-186).—Read before the British Association. The usual type of scratch test is unsuitable for exhibiting ageing changes, and a new test is developed, which produces, automatically, a permanent record of hardness changes occurring during ageing. The basis of the test is a scratch or groove, rolled by a rotating ball in a slowly-traversing specimen. The test, which is shown to be susceptible to changes of hardness due to work-hardening and age-hardening, and the results from which are readily expressed in Brinell hardness, is used to investigate periodic fluctuations of hardness following magnetic and thermal disturbances. The periodic fluctuations are attributed to electromagnetic pulsations in the atomic structure of the metal.—J. W. D.

**Atomic Structure in Relation to Hardness.** S. R. Williams (*Instruments*, 1937, 10, (3), 68-71, 82).—Modern views on atomic structure are outlined in a popular style.—J. C. C.

**Underlying Conditions in Hardness Measurements.** S. R. Williams (*Instruments*, 1937, 10, (4), 98-102).—The view is expressed that in a penetration or scratch hardness test, the value recorded depends on: (a) the angle of the indenter; (b) the resistance of the material to being torn apart; (c) its resistance to slip; and (d) the frictional resistance between material and indenter. The first and last of these factors are functions of the method of measurement. Various theories of hardness are briefly described.—J. C. C.

**Wear-Resistance in Relation to Hardness.** S. R. Williams (*Instruments*, 1937, 10, (5), 133-134; (6), 161-162, 166).—Some methods which have been



used for measuring the wear of metals (mainly ferrous) in rubbing contact are reviewed. Reference is made to the hardness testing of grinding wheels.

—J. C. C.

**Early Scratch Hardness Methods.** S. R. Williams (*Instruments*, 1937, 10, (7), 182-184, 190; (8), 208-209, 212).—It is emphasized that, whereas abrasion does not occur when a plastic material is scratched and deformation occurs by slip, it may be the major factor in producing a groove in a brittle material when small particles are torn out during the operation. For this reason, a ductile material may often scratch a harder brittle one. Moh's hardness scale is discussed, and some early scratch tests described.—J. C. C.

**Rockwell Hardness Test.** A. L. Davis (*Metals Handbook (Amer. Soc. Metals)*, 1936, 24-26).—Prepared for the Hardness Testing Committee of the American Society for Metals. Deals with the principle of the test, the preparation of surfaces, thickness of specimens, curved surfaces, recording readings and speed of machine, standardization, homogeneity of specimens, precautions to be taken, and the Rockwell superficial hardness tester.—S. G.

**Scleroscope Hardness Test.** — (*Metals Handbook (Amer. Soc. Metals)*, 1936, 27-28).—Deals with the principle of the instrument and its use, with precautions to be taken. Reasons are given for high and low readings.—S. G.

**The Monotron Hardness Test.** O. W. Boston (*Metals Handbook (Amer. Soc. Metals)*, 1936, 29-30).—Prepared for the Hardness Testing Committee of the American Society for Metals. Deals with the principle of the test, preparation of surfaces, tests on thin specimens or finished surfaces and on nitrided steels, and monotron scales.—S. G.

**Vickers Diamond Pyramid Hardness Test.** S. L. Goodale and B. B. Rosenbaum (*Metals Handbook (Amer. Soc. Metals)*, 1936, 31-32).—Prepared for the Hardness Testing Committee of the American Society for Metals. Deals with the principle of the test, the use of the instrument, and its advantages and disadvantages.—S. G.

**The Microcharacter.** C. H. Bierbaum (*Metals Handbook (Amer. Soc. Metals)*, 1936, 33-34).—Describes the instrument and its use. The instrument is not intended for commercial testing; it is for research only, in the hands of a skilled investigator.—S. G.

**Herbert Pendulum Hardness Test.** I. H. Cowdrey (*Metals Handbook (Amer. Soc. Metals)*, 1936, 35).—Prepared for the Hardness Testing Committee of the American Society for Metals. A very brief description of the instrument.—S. G.

**Cloudburst Hardness Test.** R. C. Brumfield (*Metals Handbook (Amer. Soc. Metals)*, 1936, 36-37).—Prepared for the Hardness Testing Committee of the American Society for Metals. The instrument is briefly described, and a conversion table is given from which ordinary Brinell numbers may be obtained from the measured impression diameters. B. also briefly discusses the elimination hardness test, and the Cloudburst as a surface superhardener.—S. G.

## RADIOLOGY

**Radiography.** Kent R. Van Horn (*Metals Handbook (Amer. Soc. Metals)*, 1936, 70-77).—A review, dealing with the generation of X-rays, apparatus, methods of detecting X-rays, accessory equipment, sensitivity of radiography and general technique, the interpretation of radiographs, applications of radiography, and gamma-ray radiography. A *bibliography* of 15 references is appended.—S. G.

**X-Rays and Gamma Rays—Their Industrial Applications.** Tom A. Triplett (*S.A.E. Journal*, 1937, 40, (3), 122-127; discussion, 128).—The structural variations which can be detected by diffraction methods are listed, and the applications of radiographic methods reviewed. The advantages and limitations of both types of X-ray examination are indicated. In the

discussion, the remarkable improvements resulting from radiographic examination of castings are emphasized.—H. W. G. H.

**The Application of Industrial Radiography to Engineering and Allied Subjects.** K. G. F. Collender (*Trans. S. African Inst. Elect. Eng.*, 1937, 28, (5), 109-130; discussion, 130-134).—A general review. Examples are given of the use of X-rays and  $\gamma$ -rays in the examination of welds, location of flaws in castings, and identification of crystal structures. The need for complete protection of personnel is emphasized, and the recommendations of the British X-Ray and Radium Protection Committee are given in an appendix.—C. E. R.

**X-Ray Examination of Metallic Pieces.** V. P. Kibanov (*Aviopromishlennost (Air Industry)*, 1937, (6), 47-54).—[In Russian.] K. describes the methods of X-ray examination of pieces of aluminium alloys of special shape, and discusses the causes of the typical defects in such parts, as revealed by X-rays.—N. A.

**Development and Work of the Reich's X-Ray Department of the Staatliche Materialprüfungsamt at Berlin-Dahlem up to February 1937.** O. Vaupel (*Chem. Apparatur*, 1937, 24, (9), 141-145).—Various modern outfits for the detection of flaws, segregation, &c., in castings and welds are described and illustrated.—A. R. P.

## XII.—TEMPERATURE MEASUREMENT AND CONTROL

(Continued from pp. 460-461.)

**Temperature Measuring Apparatus and Temperature Measurement in the Foundry.** O. Brauer (*Giesserei-Praxis*, 1937, 58, (29/30), 290-292; (31/32), 307-311).—Pyrometers are classified as: thermoelectric, electrical resistance, heat radiation, and optical (light radiation). The theory and examples of each class, as well as a new type of registering pyrometer, are described.—J. W.

**The Control of Temperature in Aluminium and Bronze Foundries.** Raymond Laprand (*Congrès Internat. Fonderie, Paris (Preprint)*, 1937, 3 pp.; and *Cuivre et Bronze*, 1937, 10, (86), 9, 11, 13).—Bare and sheathed thermocouples are discussed.—H. W. G. H.

**Pyrometry.** — (*Metals Handbook (Amer. Soc. Metals)*, 1936, 182-196).—Prepared by the Sub-Committee on Pyrometry, of the American Society for Metals. Deals only with thermoelectric pyrometers.—S. G.

**Optical and Radiation Pyrometry.** P. H. Dike (*Metals Handbook (Amer. Soc. Metals)*, 1936, 197-207).—After a discussion of fundamental principles, D. deals with the range and accuracy, precautions, calibration and checking, and advantages and disadvantages of the optical pyrometer and of the radiation pyrometer.—S. G.

**\*A New Thermocouple.** R. C. Mason (*Rev. Sci. Instruments*, 1937, [N.S.], 8, (8), 265).—A thermocouple constructed of Kovar and tungsten is suitable for immersion in mercury for the measurement of temperatures up to at least 600° C. Kovar, a cobalt-nickel-iron alloy, is unattacked by mercury, can be sealed into the same glass as tungsten, and the couple gives an average thermoelectric power from 0°-100° C. of about 40 micro-v. per ° C., i.e. about the same as Chromel-Alumel couples.—J. S. G. T.

**Gallium Thermometers.** Praktikus (*Glas u. Apparat*, 1935, 16, (19), 178; *Ceram. Abs.*, 1936, 15, 32).—The replacement of mercury in thermometers up to 1000° C. by gallium, which boils at 2000° C. and freezes at 27° C., has been tried, but no satisfactory solution has been found; in spite of the extreme purity of the gallium used there always remained a black residue in the capillary. Further research is recommended, since a gallium thermometer would not need filling under high pressure as does the mercury thermometer with the nitrogen atmosphere in the capillary.—S. G.



\*Use of an Alternating Current Bridge in Laboratory Temperature Control. Manson Benedict (*Rev. Sci. Instruments*, 1937, [N.S.], 8, (8), 252-254).—An a.c. bridge circuit and amplifier for continuous temperature control of furnaces and thermostats is described. The circuit is simple and portable, and can be made from standard electrical equipment. The power output of the circuit is doubled for a change of 0.03% in the resistance of the regulating thermometer. Regulated power up to 500 watts is obtainable on a 230 v. circuit. Control of a furnace containing a 10 lb. copper block at 300°-500° C. has been effected to within 0.03° C. per hr.—J. S. G. T.

### XIII.—FOUNDRY PRACTICE AND APPLIANCES

(Continued from pp. 461-462.)

**Defects in Difficult Castings.** J. L. Francis (*Iron Steel Ind.*, 1937, 10, (14), 598-602).—Various methods for eliminating defects in castings are discussed, including conditions for minimum shrinkage defects, and the use of risers, feeding heads, densers, and inserts. Consideration is also given to the Léonard Effect, the design of the casting in producing defects, and defects resulting from coring. The effect of undesirable head cooling, and the pouring speed and temperature, are also dealt with.—J. W. D.

**The Influence of Solidification Conditions in Aluminium Castings.** R. Irmann (*Congrès Internat. Fonderie Paris (Preprint)*, 1937, 6 pp.).—[In French.] The effects of cooling rate on grain-size and, in turn, on mechanical properties, are illustrated by examples of castings in sand and chill, castings poured at different temperatures, and castings made in chills at different temperatures. The effect of additions of titanium or cerium are also shown. Cooling conditions after solidification are discussed, with respect to contraction and hot-shortness.—H. W. G. H.

**The Influence of Sodium on the Formation of Cavities and Blow-holes in Aluminium.** B. Grashshenko and V. Darovski (*Legkie Metalli (Light Metals)*, 1936, (10), 54-56).—[In Russian.] In a previous paper (see *Met. Abs.*, 1936, 3, 573), G. and D. showed that, on adding sodium to aluminium, the castings contained blow-holes and cavities. They now refute the opinion of certain technicians, that blow-holes in ordinary aluminium castings can be attributed to the presence of sodium, as the sodium content is negligible.—D. N. S.

**Points of View in the Selection and Manufacture of Aluminium Casting Alloys.** A. von Zeeleder (*Giesserei*, 1937, 24, (13), 317-319).—For thick castings, a eutectic alloy on a silicon-aluminium basis gives the strongest castings. The strength of sand-castings decreases with increasing wall-thickness, but this may be overcome by inserting chills in the sand opposite the thick parts. Cast iron crucibles are recommended for melting; they should be coated inside every day with a wash of a mixture of clay 50, water 45, and water-glass 5%. Scrap should first be melted separately, the dross removed, and the metal cast into bars to allow gases to escape and impurities to segregate to a position where they can be removed. Any flux used in cleaning the molten metal must be anhydrous, and the temperature should not exceed 800° C. to avoid gas absorption.—A. R. P.

**On the Preparation of Aluminium-Nickel Hardening Alloy.** H. Röhrig and E. Käpernick (*Aluminium*, 1937, 19, (6), 428).—In making "Y" alloy, the nickel is preferably added as a hardener alloy of 80% aluminium and 20% nickel. This hardener is made by heating thin nickel sheet in a crucible in a non-oxidizing atmosphere to 800° C., and then pouring in the required amount of aluminium, previously heated to 800° C.; a vigorous exothermic reaction

takes place, the temperature increases to about 1000° C., and the alloy is immediately ready for casting.—A. R. P.

**Some Points to be Observed in the Melting of Light Metals.** M. Schied (*Giesserei-Praxis*, 1937, 58, (25/26), 250-253).—S. discusses the importance of controlling the addition agents, and the quality of virgin and secondary material, in the melting of aluminium and magnesium alloys, and the testing of copper-, zinc-, magnesium-, and silicon-containing aluminium alloys and electron. Details are given of the melting of these alloys.—J. H. W.

**Moulding and Pouring a Casting in Anticorodal.** — (*Giesserei-Praxis*, 1937, 58, (29/30), 294-297).—Describes the moulding melting, and pouring of a casting in Anticorodal.—J. H. W.

**Light Metals in the Moulding Shop.** — Pohl (*Giesserei-Praxis*, 1937, 58, (29/30), 300-302).—P. describes the construction of moulds for aluminium and aluminium alloy castings, and the machining of such castings.—J. H. W.

**Important Points Which Must Be Observed in the Production of the Mould for Aluminium Castings.** — (*Giesserei-Praxis*, 1937, 58, (35/36), 353-356).—Describes the preparation of moulds and cores for aluminium castings, and the precautions to be taken for the production of sound castings.—J. H. W.

**"Winding" the Rotors for Squirrel Cage Motors by Casting.** Frank S. Dobric (*Met. Ind. (N.Y.)*, 1937, 35, (5), 210-211).—The pressure casting of aluminium or magnesium rotor rings, complete with bars, is described, with reference to photographs of the various operations.—A. R. P.

**Difficulties in the Manufacture of Aluminium Rings.** — (*Giesserei-Praxis*, 1937, 58, (33/34), 332-334).—Describes the moulding and casting of 2 types of large aluminium rings, and the precautions to be taken to avoid the slightest porosity or slag inclusion.—J. H. W.

**Deoxidation of Copper with the Lithium-Calcium Alloy.** M. Reifman (*Novosti Tekhniki (Tech. News)*, 1937, (9), 9; *C. Abs.*, 1937, 31, 7014).—[In Russian.] Copper was freed from oxides, gases, and bubbles by treatment with 0.0125% of a lithium-calcium alloy at 1150° C. The mechanical and electrical properties of the refined copper were the same as those of the untreated metal. The lithium-calcium alloy was prepared by electrolyzing molten calcium chloride and lithium chloride. Both metals were deposited on the cathode. The alloy obtained was homogeneous, and melted at 530°-650° C., depending on the content of lithium, which sharply decreases the melting point of the alloy.—S. G.

**The Manufacture of Heavy Copper-Shaped Castings.** E. T. Richards (*Giesserei-Praxis*, 1937, 58, (23/24), 230-234).—Copper is one of the most difficult metals for shaped castings, partly owing to the usual technical difficulties of casting the metal, but also owing to the ease with which it becomes contaminated after even short contact with the atmosphere. The method of overcoming these difficulties is discussed in some detail.—J. H. W.

**A Large Manufacturer of Nickel Silver, Phosphor-Bronze, and Nickel Anodes.** — (*Met. Ind. (N.Y.)*, 1937, 35, (2), 51-56).—A description is given of the products, plant, and manufacturing methods of an American firm, and the history and uses of nickel silver and phosphor-bronze are reviewed.—A. R. P.

**A New Method of Alloying Bronzes.** R. Ozlberger (*Giesserei*, 1937, 24, (10), 251-254).—Addition of a small quantity of nickel to the ordinary 8% tin-bronze results in the production of homogeneous castings, which can be heat-treated to produce a tensile strength of 60 kg./mm.<sup>2</sup>, a yield-point of 50 kg./mm.<sup>2</sup>, and a Brinell hardness of 180. The introduction of a small amount of silver into the nickel-bronze results in still further improvement in these properties to 72 kg./mm.<sup>2</sup>, 66 kg./mm.<sup>2</sup>, and 220, respectively, after appropriate heat-treatment.—A. R. P.

**Gun-Metals and Tolerances.** — (*Found. Trade J.*, 1937, 56, (1082), 395-396).—Report of a discussion by the Lancashire Branch of the Institute of



British Foundrymen on the papers "Recommendations for Two Leaded Gun-metals," by E. J. L. Howard, and "Dimensional Tolerances for Castings," by F. K. Neath. The relation between tensile strength and density, the effect of pouring temperature, the design of the test-bar, and the lack of concise conclusions in the report on gun-metals were among the points discussed.

—J. C. C.

**Notes on the Use of Sodium Carbonate in Bronze Founding.** — (*Cuivre et Bronze*, 1936, 9, (73), 7, 9, 11).—The effects of adding at least 1% of sodium carbonate, preferably with a little  $MnO_2$  to combine with dissolved hydrogen, when melting bronze are briefly discussed. With these additions, it is possible to melt in an oxidizing atmosphere to reduce the absorption of reducing gases, and the sodium carbonate will flux away any oxides and, in particular, will remove sulphur. The tensile strength of a bronze, to which calcium sulphate was intentionally added during melting, was increased from 11 to over 21 kg./mm.<sup>2</sup> on remelting with sodium carbonate.—J. C. C.

**Pattern and Gating Design for Bronze Castings.** Harold J. Roast (*Foundry*, 1937, 65, (6), 24–26, 77).—The need for close collaboration between designer, pattern-maker, metallurgist, and foundryman is stressed, and then the principles governing the design of gates, runners, and risers are outlined. These principles are illustrated by three examples: a plain disc, a 22-in. diam. ring of 2 in.  $\times$  1 in. section, and plain bushes. In each case, particular attention is paid to eliminating dross before the metal enters the casting. A keel block test-piece for bronze, and a method of pouring a bronze stick, to show uniform attack after deep etching, are also described.—H. W. G. H.

**Specializes in Bronze Valves.** Pat Dwyer (*Foundry*, 1937, 65, (8), 22–24, 66, 68).—The foundry of Jenkins Bros., Bridgeport, Conn., U.S.A., is described. The moulds for valve parts are made on machines and the cores are blown. The alloys used, mainly gun-metal, brass, and bronze, of which particulars are given, are melted in Detroit furnaces, which, it is claimed, consume 145 kw. per 1100 lb. of metal melted.—H. W. G. H.

**Solving Problems Encountered in Non-Ferrous Foundries.** R. J. Kceley (*Foundry*, 1937, 65, (8), 48, 50, 53).—See *Met. Abs.*, this vol., p. 300.—H. H.

[Discussion on] **Foundry Problems.** — (*Found. Trade J.*, 1937, 56, (1086), 463).—Report of an open discussion by the West Yorkshire Branch of the Institute of British Foundrymen. Increasing the air supply was suggested as a possible cure for fine pin-holes encountered in phosphor-bronze castings when a change was made from coke- to gas-firing. Hard cores and variations in temperature were among the causes suggested for variations in the length of castings from the same pattern.—J. C. C.

**Gases in Bronzes.** Charles Dennery (*Cuivre et Bronze*, 1936, 9, (74), 7, 9, 11, 13, 15, 17, 19).—Extract from a paper entitled "Some Phenomena which Accompany the Melting of Bronze," see *Met. Abs.*, 1936, 3, 318.—J. C. C.

**Economizing in Metal by Casting-On [Brass or Bronze Layers].** E. Krupp (*Giesserei*, 1937, 24, (20), 485–487).—Owing to the comparative scarcity and relatively high price of copper in Germany, economies in construction of mechanical parts are effected by making them of cast iron instead of copper alloys (brass, bronze, &c.), and then casting-on a relatively thin brass or bronze layer at the working surface. Numerous examples are illustrated and described, including large valves, cocks, and spindles.—A. R. P.

**Correct Planning of Castings of Elektron Metal.** P. Spitaler (*Giesserei*, 1937, 24, (16), 389–396).—The physical and mechanical properties of various Elektron-type alloys are tabulated, and instructions are given, with reference to diagrams, of the correct way of planning sand moulds and arranging cores, gates, and risers to produce sound, strong castings of various types.—A. R. P.

**Crystallization and Structure of Elektron Alloys.** K. V. Peredelskiy (*Metallurg (Metallurgist)*, 1937, (1), 115–117).—[In Russian.] The best mould

temperature for casting the alloy of magnesium with 8% aluminium is 150° C. Up to 150° C. the increase in grain-size is only a comparatively slow one; above this temperature the growth of the grains becomes more intensive.—N. A.

**Improvement of the Properties of Standard Babbitt by Means of Reduction.** S. Shpagin (*Novosti Tekhniki (Tech. News)*, 1937, (12), 28–29; *C. Abs.*, 1937, 31, 7014).—[In Russian.] A “preliminary” alloy, heated to 600° C., is treated with wood, which is secured to the iron stirrer. Decomposition of the wood proceeds, with evolution of reducing gases, which promote the mixing of the metals and partially reduce oxides in the “preliminary” alloy. With a large quantity of Babbitt, the process should be repeated for a final reduction of unchanged oxides. The well-known method of phosphorus treatment of Babbitt was also investigated, and its effectiveness was disclosed.—S. G.

**Centrifugal Casting.** P. E. Ljamin (*Zvetnye Metally (Non-Ferrous Metals)*, 1937, (4), 86–89).—[In Russian.] L. points out the good results obtainable in the application of centrifugal casting to non-ferrous alloys (e.g. Duralumin, brass, and bronze).—N. A.

**Pressure Casting in Modern Machine Building.** K. V. Peredelsky (*Machinostroitel (Machine Builder)*, 1937, (11), 6–8).—[In Russian.] A review.

—N. A.

**\*Portland Cement as a Binder for Foundry Moulding Sand.** Carl A. Menzel (*Trans. Amer. Found. Assoc.*, 1937, 45, 200–216; discussion, 216–224).—A laboratory investigation is described to show the effects, on strength and permeability of cement-foundry sand mixtures, of the type of cement, cement content, moisture content, type of sand, degree of ramming, temperature and age of mix. The results indicate that fresh, clean silica sand should be mixed with about 10% cement and 4½% moisture. If this facing mixture is made with high early strength portland cement, and protected from loss of moisture for 24 hrs., it will have excellent strength and permeability 2 or 3 days after moulding, even though dried rapidly after the initial 24-hr. period. Mixtures at normal temperature should be rammed within 2½ hrs. after mixing.—H. H.

**Sand Control at the Northern Indiana Brass Company.** A. C. Arbogast (*Trans. Amer. Found. Assoc.*, 1937, 45, 122–124; discussion, 124–129).—A sand of A.F.A. grain-size 157 and clay content 18.8% is used for large castings, and one of grain-size 188 and clay content 13% is blended with this for small castings. For large castings, the permeability is about 17–21, moisture about 6–7%, and green compression strength 6.4–7. For small castings, the best results are obtained with moisture 6–6.5%, permeability 13.5–15.5, and green compression strength 6.2–6.7.—H. W. G. H.

**“Corecoat.”** — (*Found. Trade J.*, 1937, 56, (1085), 443).—“Corecoat” is a proprietary mould and core dressing for non-ferrous alloys.—J. C. C.

**Dust Control in the Foundry.** C. A. Snyder (*Met. Ind. (N.Y.)*, 1937, 35, (7), 349–350).—The operation of various types of dust collectors for removing the dangerous dusts produced in sand-blasting operations, and from grinding wheels, &c., is briefly discussed.—A. R. P.

**Mineralogical Composition of Air-Borne Foundry Dust.** Theodore Hatch and Charles B. Moke (*J. Indust. Hyg.*, 1936, 18, (2), 91–97).—S. G.

**Accident Prevention in the Foundry.** — Heckmann (*Giesserei-Praxis*, 1937, 58, (25/26), 258–262).—H. describes the numerous ways in which accidents can occur in the foundry and its allied shops, and the factors which can adversely affect the health of the workmen, and suggests means for avoiding the former and mitigating the effects of the latter.—J. H. W.



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

(Continued from p. 462.)

Recovery of Battery Scrap and Residues by Metallurgical Processes. Edmund R. Thews (*Canad. Chem. and Met.*, 1937, 21, (1), 17-19).—Modern practice is described, and the economics of the various processes are discussed.

—A. R. P.

The Attainment of the Quality of the Original Primary Aluminium by Suitable Treatment of Secondary Aluminium. W. Guertler (*Z. Elektrochem.*, 1937, 43, (8), 502).—A very short abstract of a paper read before the Deutsche Bunsen-Gesellschaft.—J. H. W.

\*Electrolytic Detinning of Tinplate Scrap, and a Micro-Method for Determining Its Lead Content. A. M. Zanko and N. S. Krugovoi (*Ber. Inst. physikal. Chem., Akad. Wiss. Ukrain. S.S.R.*, 1936, 6, 247-265; *C. Abs.*, 1937, 31, 6975).—[In Russian, with German summary.] The tin layer was first removed by anodic oxidation in sodium hydroxide solution. The stannate solution was then electrolyzed to eliminate lead as  $PbO_2$ . The  $PbO_2$  was then collected, and determined iodometrically or colorimetrically.—S. G.

## XV.—FURNACES AND FUELS

(Continued from pp. 462-463.)

Crucible Furnaces or Rotary Furnaces? W. Wilhelmson (*Giesserei-Praxis*, 1937, 58, (33/34), 334-335).—Recent advances in the construction of both crucible and reverberatory furnaces are indicated, and the various factors which affect the melting of non-ferrous metals and alloys in these two types of furnace are discussed and compared. As a result, it is concluded that, for melting, the crucible furnace is unconditionally superior to the reverberatory furnace.

—J. H. W.

The Melting of Valuable Heavy Metal Alloys in Gas-Fired Rotary Furnaces Without a Crucible. Herbert Pontzen (*Gas* (Düsseldorf), 1937, 9, (5), 128-131).—The technique of erecting and using non-crucible rotary or tilting furnaces for melting alloys, e.g. manganese-bronze, brass, &c., is described and illustrated. On the average, the gas used in such furnaces is about 25 m.<sup>3</sup> per 100 kg. of charge, as compared with 30 m.<sup>3</sup> per 100 kg. in a crucible furnace. Data obtained with a furnace taking a charge of 500 kg. are given for various alloys; smaller furnaces taking a smaller charge of 100 kg. have also been erected. Constructional details are very important, and attention must be given to the flux used.—J. S. G. T.

Experiences and Operating Results Obtained With Gas-Heated [Lead] Melting Pots. — Zander (*Gas* (Düsseldorf), 1937, 9, (4), 86-89).—Experience in a printing works in the melting and casting of lead and type-metal in pots heated by town's gas is stated.—J. S. G. T.

Gas-Heated Annealing and Heat-Treatment Furnace Using Hot Air. Georg Aigner (*Gas* (Düsseldorf), 1937, 9, (3), 57-58).—Large and small annealing or heat-treatment furnaces, employing a circulation of heated air and products of combustion of town's gas as heating medium, are described. The dimensions of the heating chambers and the working temperatures of these furnaces are, respectively: 70 cm. × 200 cm. × 80 cm., 300°-650° C., and 50 cm. × 75 cm. × 30 cm., 150°-350° C.—J. S. G. T.

†Gas-Heated Steel Pipes and Protecting Gas [Annealing of Copper and Brass]. — Trutnovsky (*Gas* (Düsseldorf), 1937, 9, (2), 48-50).—American developments in the use of steel tubes heated internally by the combustion of town's gas, and in the use of partially-burnt gas as a protecting device in heating

processes, are described and illustrated. Matters more particularly dealt with are the heating of enamelling ovens and the annealing of copper and brass.

—J. S. G. T.

**Heat-Treatment of Non-Ferrous Metals.** Günther Klatte (*Gas* (Düsseldorf), 1937, 9, (1), 13-17).—Plant using town's gas for melting, hot-pressing, annealing, and heat-treating non-ferrous metals is described and illustrated.

—J. S. G. T.

**The Use of Gas in Workshops.** — Diebitsch (*Gas* (Düsseldorf), 1937, 9, (1), 4-8).—Industrial applications of town's gas in workshops, e.g. for effecting motor repairs, for heating small or large forgings, rivet heating, hardening are briefly described and illustrated.—J. S. G. T.

**The Gas Flame as a Tool.** — Flothow (*Gas* (Düsseldorf), 1937, 9, (1), 8-13).—The uses of a gas flame for soldering, cutting, hardening, and welding are described; suitable appliances are illustrated.—J. S. G. T.

**\*Temperature Limits With Fuel Gases With and Without Reference to the Dissociation Phenomena in the Combustion Products.** H. Brückner and W. Bender (*Gas- u. Wasserfach*, 1936, 79, (39), 701-705).—The theoretical principles of a "limiting temperature" of burning gases are discussed, and approximate expressions for calculating it are given; with their aid it is possible to calculate the upper temperature limit obtainable in burning a gas without excess of air from the lower calorific value of the gas and the quantity and composition of the combustion products. New values have been calculated for the degree of dissociation of carbon dioxide and water vapour as a function of the partial pressure and combustion temperature.

—B. Bl.

**"Autocalor," an Automatic Bottom-Firing System for Industrial Furnaces.** — (*Draht-Welt*, 1937, 30, (22), 259-260).—Fuel is fed in below the hearth by means of a worm drive, operated by a motor which also controls the draught. The air passes through heating tubes surrounding the hearth before it enters the combustion chamber. The method of incorporating the device in muffle and crucible furnaces is illustrated, suitable fuels are recommended, and an estimate of consumption is given.—P. R.

**Industrial Heating Furnaces.** M. H. Mawhinney (*Metals Handbook* (Amer. Soc. Metals), 1936, 147-155).—Deals with electric and fuel-fired furnaces for heat-treating purposes, operating at all temperatures up to about 1300° C. It does not discuss melting furnaces, or electric furnaces of the arc or the induction type.—S. G.

**Electric or Fuel-Heated Hearth Melting Furnaces for Melting Aluminium.** H. Sauer (*Elektrowärme*, 1937, 7, (9), 202-204).—The use of oil-fired reverberatory furnaces for melting aluminium results in a greater gas absorption and a greater loss by oxidation than the use of electric furnaces. In Germany, electricity costs 3 R.Pf. per kw.-hr. and fuel oil 12 R.M./100 kg.; comparative tests have shown that with a loss in dress of 0.9% in the electric furnace and 1.5% in the oil-fired furnace the former effects an economy of 2.8 R.M./ton despite a fuel cost of 60% more.—A. R. P.

**Modern Electric Melting Furnaces.** W. Jaeckel (*Chem. Apparatur*, 1937, 24, (6), 81-85).—Arc and high-frequency induction furnaces are described.

—A. R. P.

**On a Modern Electrically-Heated Circulating Atmosphere Furnace for the Heat-Treatment of Light Metal Sheets.** H. Dicks (*Elektrowärme*, 1937, 7, (6), 117-122).—The furnace is divided into zones, each of which has its own heating elements, and a device for the transverse circulation of the air; special arrangements are made for quenching the charge. The furnace and some modifications of it are illustrated, and its operation explained by diagrams.

—A. R. P.



**Furnaces and Atmospheres for Annealing Copper with Electric Heat.** E. K. Hansen and P. H. Brace (*Metals and Alloys*, 1937, 8, (8), 215-219; supplementary comment by P. H. Brace, 219-220).—Various modern types of bright-annealing furnaces with controlled atmospheres are illustrated and described briefly.—A. R. P.

**Electric Heating in the Heavy Industry.** Fr. Knoops (*Elektrotech. Z.*, 1936, 57, (40), 1145-1148).—Types of annealing, bright-annealing, and hardening furnaces are described.—B. Bl.

**Choice of Materials for Electric Heating.** W. Hessenbruch (*Elektrotech. Z.*, 1936, 57, (40), 1134).—The conditions under which metallic heating elements can be used are discussed.—B. Bl.

**Resistance Materials for Electric Heaters.** A. Thum and F. Meyercordt (*Elektrotech. Z.*, 1936, 57, (40), 1135-1139).—The factors which govern the choice of materials for the construction of electric heaters are discussed.—B. Bl.

**\*Some Principles of the Construction of Electric Furnaces.** Wilhelm Fischer (*Elektrotech. Z.*, 1937, 57, (40), 1139-1144).—In selecting a suitable heating element, not only must the properties of the material be taken into account, but also the load-carrying capacity of the element; the effects of shape and arrangement on this factor and on the heat radiation has been studied, and a method is given for determining heat losses in continuous furnace operation.—B. Bl.

**Design and Selection of Heat-Enduring Alloys for Industrial Furnaces.** R. Stuart Brown (*Indust. Heating*, 1935, 2, (9), 495-498; *Ceram. Abs.*, 1936, 15, 35).—The principal requirements for such alloys are: (1) oxidation-resistance, so that they last indefinitely at the operating temperature; (2) structural ability, in particular permanent ductility under heat; (3) corrosion-resistance against sulphur for use with some fuels; and (4) high-temperature creep strength. Oxidation- and corrosion-resistance are largely determined by chromium and nickel content; structural ability and creep strength depend almost entirely on the minor elements in the composition and the methods employed for melting and casting. Correct design and use of practical data are discussed.—S. G.

## XVI.—REFRATORIES AND FURNACE MATERIALS

(Continued from p. 463.)

**Properties of Refractories.** F. H. Norton. S. M. Phelps (*Metals Handbook (Amer. Soc. Metals)*, 1936, 159-163).—Tables of the chemical, physical, thermal, and electrical properties of commercial refractories, and of the properties of pure refractory materials, are given.—S. G.

**Cements in Refractory Masonry.** Marcel Lépingle (*Verre et Silicates Ind.*, 1936, 7, (3), 27-29; (4), 38-41; (5), 50-52; *Ceram. Abs.*, 1936, 15, 180).—Different types of cements, their behaviour on firing, determination of the softening curve with heat under constant weight, and examples from practice are discussed.—S. G.

**Savings with Insulating Refractories.** J. G. Coutant (*Chem. and Met. Eng.*, 1937, 44, (3), 137-138).—Great savings in heating times and fuel consumption are obtained from the use of insulating refractories in the construction of furnaces. One instance is cited in which the gas-consumption of a furnace was reduced from 1350-1500 ft.<sup>3</sup> to 300 ft.<sup>3</sup> per hr. by the use of insulating refractories. One such refractory is described; it is made of expanded fireclay having a density in blocks of  $< \frac{1}{4}$  that of firebrick. Insuline firebrick may be used up to 1540° C., and insulating blocks up to 1200° C. A still lighter grade of block has been developed, the heat capacity of which is only  $\frac{1}{10}$  that of first quality firebrick. Thus a very large reduction in heat-storage by the furnace

walls can be effected. Data and curves are given showing the economies which can be obtained by combining high insulating effect with low heat storage.

—F. J.

**\*Effect of Carbon Monoxide on Refractory Products.** A. I. Kramarenko (*Novosti Tekhniki (Tech. News)*, 1934, (59), 15; *Ceram. Abs.*, 1936, 15, 22).—[In Russian.] Grog bricks containing from 3 to 6% hematite, pyrite, magnetite, and metallic iron were tested for their resistance to carbon monoxide. It was found that: (1) the destruction of grog brick increases with increased iron content; (2) the coarser the addition, the more rapidly the bricks are destroyed; and (3) a more severe firing of the bricks increases their resistance, although much better results were obtained when 5–10% powdered amorphous quartzite was added.—S. G.

**Method of Testing Aluminous Refractory Materials at High Temperature.** B. Long (*Rev. mat. constr. trav. publ.*, 1935, (310), 110–111B; *Ceram. Abs.*, 1936, 15, 23).—L. recommends the recording of the softening under load at constant temperature of a cylinder 5 cm. in diam. and 5 cm. high. The equipment, furnace, pyrometer, and Wilson-Maeulen temperature regulator are described. After application, the softening curve is registered during at least 12 hrs. The different results obtained are compared with those of former tests at variable temperature. With the new method the influence of the total porosity can be detected. After contraction of the pores, the apparent viscosity intervenes; it characterizes the industrial value of a silico-aluminous refractory.—S. G.

**Effect of Heat-Treatment on Spalling of Clay Refractories.** S. M. Phelps (*Pennsylvania State Coll. Mineral Ind. Exper. Sta. Bull.*, 1934, (14), 57–66; *Ceram. Abs.*, 1936, 15, 22).—The fact that spalling of refractories in service is a major cause of failure has promoted much study of the subject. The factors involved in spalling are discussed from the following points of view: (1) set-up of stresses within the brick as a result of vitrifying one face of the refractory previous to spalling; (2) change in reversible thermal expansion caused by heat-treatment of the face; (3) effect of heat-treatment or vitrification on the rheelasticity within the brick structure; and (4) cracking of the face of the brick so as to form an interlocking of the structure of adhering particles.—S. G.

**The Need for the Classification and Grading of Firebricks.** John W. Wright (*Refract. J.*, 1937, 13, (2), 103, 105).—Scottish makers of firebricks grade their products into 3 classes. The extension of the policy to English manufacturers is recommended. Bricks should also be classified as regards their suitability for certain specific purposes.—J. S. G. T.

[**Olivine and Forsterite.**] R. E. Birch (*Refract. J.*, 1937, 13, (2), 108–109).—B. corrects mis-statements occurring in the literature relating to the compositions and melting points of olivines and forsterite. The correct value for forsterite is 1890° C. and not 1460° C. The forsterite-fayalite olivines equilibrium diagram is given, and is briefly discussed.—J. S. G. T.

**\*†Casting Pit Refractories.** A. McKendrick (*Refract. J.*, 1937, 13, (2), 63–65, 67, 69–71, 143, 145, 147–149, 153, 155, 157–158).—Details to which attention must be paid in the manufacture of casting pit refractories are discussed in considerable detail. Matters discussed include: the quality of raw materials, grading, firing, shape and size, storage, ladles, linings, density, porosity and permeability, nozzles, rod covers, stopper ends, and guide tubes.

—J. S. G. T.

[**Refractability.**] W. J. Rees, A. B. Searle, Frank S. Russell, and James Watson (*Refract. J.*, 1937, 13, (2), 107–108; (3), 169; (4), 246).—Opinions are expressed for and against the use of the word "refractability" in place of "refractoriness."—J. S. G. T.

**Texture.** A. E. Dodd (*Refract. J.*, 1937, 13, (5), 293–294, 297).—Six types of pores found in firebricks are described. The relations between texture



and spalling resistance, slag resistance and heat transmission are briefly discussed.—J. S. G. T.

†**Developments in the Refractories Industry Reviewed from the American Standpoint.** — (*Refract. J.*, 1937, 13, (1), 10-19).—Developments in the manufacture, testing, and use of refractories in the period Aug. 1935-Sept. 1936 are briefly reviewed. A *bibliography* of 27 references is appended.—J. T.

## XVII.—HEAT-TREATMENT

(Continued from p. 305.)

**Heat-Treatment of Metals.** — (*Metals Handbook (Amer. Soc. Metals)*, 1936, 87-95).—Prepared by the Sub-Committee on the Heat-Treatment of Metals, of the American Society for Metals. The object of the article is to present fundamental principles which are applicable to the heat-treatment of all metals—ferrous and non-ferrous.—S. G.

**Atmosphere from Hot Charcoal for Annealing Copper.** H. D. Holler (*Metals and Alloys*, 1937, 8, (6), 181-182).—A satisfactory slightly reducing atmosphere for bright-annealing copper can be obtained by passing air through charcoal heated at 500°-550° C.; the gas contains 2.5-5% of carbon monoxide. The air used should be dry before use, in order to ensure absence of hydrogen in the gas, and thus prevent embrittlement of the copper.—A. R. P.

**The Effect of Manganese on the Annealing-Brittleness of Cupro-Nickel.** (Blazey.) See p. 497.

\***Studies on the Cooling Action of Quenching Liquids by the Schlieren Method.** Gunji Shinoda and Kyōiti Tatibana (*Trans. Soc. Mech. Eng. Japan*, 1937, 3, (11), 151-152).—[In Japanese, with English summary in foreign edition, p. 31.] The abstraction of heat from a Duralumin rod heated at about 500° C., and quenched by plunging in a liquid, occurs in two parts: (1) an initial transient stage, in which heat is abstracted by rapid fluid flow normal to the surface of the rod; and (2) by convection round the rod. With water or a solution of common salt (10%) as quenching liquid, most of the abstraction of heat occurs in the initial stage; with glycerine or castor oil most of the heat is abstracted slowly in the second stage.—J. S. G. T.

## XVIII.—WORKING

(Continued from pp. 463-465.)

**Causes of Cracks in the Cold-Rolling of Brass Ingots (68% Cu).** S. A. Kushakevich (*Metallurg (Metallurgist)*, 1937, (1), 100-106).—[In Russian.] The main cause of cracks in the cold-rolling of brass with 68% copper lies in the presence of long-shaped inclusions of the  $\beta$ -phase on the boundaries of columnar crystals. The existence of pores and cracks in the ingots is also of considerable importance. Ingots of this kind cannot be improved by any additional treatment. The presence of the  $\beta$ -phase, as well as that of microscopic pores, does not affect the hot-rolling of brass. The failures of the ingots are caused by too high a rate of cooling during crystallization. It is necessary, therefore, to develop appropriate methods of cooling and to choose lubricants of appropriate composition for each shape and size of the ingots. The casting of cold metal from Ajax furnaces is especially to be avoided.—N. A.

**Hot-[and Cold-]Rolling of Non-Ferrous Metals.** F. A. Fox (*Machinery (Lond.)*, 1937, 50, (1300), 727-730).—A general account of the types of equipment used for hot-rolling plate, sheets, strip, and rod, and for cold-rolling strip and sheet. The relationship between roll diameter and the reduction effected by a given pressure is briefly indicated.—J. C. C.

**Influence of the Degree of Reduction on the Properties of Cold-Rolled Brass Sheet (Ms 63).** (Ostermann.) See p. 498.

**Essential Conditions for the Perfect Operation of Roller-Finishing Machinery in Cold-Rolling.** Otto Emicke and Heinz Benad (*Kalt-Walz-Welt* (Suppt. to *Draht-Welt*), 1937, (3), 13-15).—The tendency to employ rolls of increasing surface hardness has necessitated their correspondingly rapid and accurate adjustment. Surface flaws are often attributed to vibrations in the machinery itself, but measurements under a variety of conditions show that such vibrations are negligible as compared with those due to adjacent heavy machinery, to transport by cranes, &c., in the works, and to heavy vehicular traffic in the vicinity. Finishing machinery should therefore be erected as far as possible from other machines, and methods for providing a suitable foundation are discussed.—P. R.

**Developments in Cold Strip Mills.** John L. Young (*Met. Ind. (Lond.)*, 1937, 51, (7), 151-154).—A long review-abstract of a paper presented to the Association of Iron and Steel Engineers, surveying recent progress in American practice.—H. W. G. H.

**The Manufacture of Finned Tubing of Copper or Aluminium.** Edwin F. Cone (*Metals and Alloys*, 1937, 8, (5), 133-135).—High-conductivity copper is extruded into tubes at 730° C., and these are straightened, quenched, bright-annealed at 620° C., and passed through the finning machine. Aluminium tubes can be prepared in a similar way; they require annealing at 455° C. before finning.—A. R. P.

**Extruded Zinc Parts Produced by Impact Method.** Herbert Chase (*Product Eng.*, 1937, 8, 214-215; *C. Abs.*, 1937, 31, 6591).—A discussion, with 4 photographs, of a wide range of zinc parts made by the extrusion process.—S. G.

**The Metallurgical Aspect of Fourdrinier Wire.** H. H. Parrett (*Proc. Tech. Sect. Paper Makers' Assoc.*, 1937, 17, (2), 339-355).—See *Met. Abs.*, this vol., p. 114.—S. G.

**"Gold" Thread.** (*Leonische Drähte*.) A. Wogrinz (*Draht-Welt*, 1937, 30, (9), 101-104).—Fine metal thread for use in ornamental textile work may be drawn from: (a) a single metal or alloy; (b) a cylinder of base metal mechanically coated with the more costly material; (c) rod coated by annealing or cementation; or (d) wire coated electrolytically. Diameters, corresponding with the Vienna gauge for wires of this type, are tabulated. Copper or alloy bases are now used in preference to silver, or alloy bases of Alpaka (a copper-nickel-zinc alloy) are silvered and then gilt. Data regarding the electro-deposition of silver and gold are summarized in a series of formulæ.—P. R.

**The Future Training of Apprentices in Wire-Working Processes.** W. Schulze (*Draht-Welt*, 1937, 30, (24), 283-284; (25), 295-296).—The recently-revised requirements of the German Chamber of Commerce, the National "Industry" group, and the Committee for Technical Education are enumerated and amplified, and a 4-years' training scheme is suggested in connection with locksmiths' work. Special courses in other branches are outlined.—P. R.

**Sheet Metal Working Processes.** — (*Junkers Nachr.*, 1937, Jan.; and *Aircraft Eng.*, 1937, 9, (98), 104-105).—The first part deals with deep-drawing in presses for the production of components in high-grade light alloys, and the rest with the stretching of sheets over wooden formers to obtain particular shapes.—H. S.

**The Properties of Sheet Metal. II.—The Testing of Deep-Drawing Quality Sheet.** J. D. Jevons (*Met. Ind. (Lond.)*, 1937, 51, (13), 310-313).—Completion of Part II of this series of articles; see *Met. Abs.*, this vol., p. 464.—H. H.

**The Properties of Sheet Metal. III.—Specification of Deep-Drawing Quality Sheet.** J. D. Jevons (*Met. Ind. (Lond.)*, 1937, 51, (14), 335-340).—It is necessary to specify the chemical composition of deep-drawing sheet



in so far as certain impurities are deleterious. It must be remembered, however, that chemical analysis gives average values, and may not disclose local segregation. The inclusion of the usual tensile requirements in a specification is of doubtful value, but the full stress-strain diagram provides useful information, and stipulations with regard to its shape may be included in specifications of the future. Hardness values indicate the probable similarity of one sheet with another of similar hardness. Cupping values, such as given by the Erichsen test, should be specified with the thickness of the sheet and the smoothness of the surface after cupping. The inclusion of tear-length values in a specification is to be recommended to prevent directionality, and the "average grain-size" should always be specified. In the present state of knowledge of deep-drawing phenomena, it is essential that specifications for material should encourage, rather than eliminate, close co-operation between supplier and user.—H. W. G. H.

**\*Investigation of the Deep-Drawability of Metals.** (Fournier). See p. 537.

**The Design of Dies and Tools for Presswork.** N. C. Wilson (*Trans. Manchester Assoc. Eng.*, 1936-1937, 183-210; discussion, 210-214).—The types of presses in general use are briefly described, and an account given of the design of tools for blanking, drawing, and reverse drawing. Some special combined and bulging tools are described, and the characteristics of various lubricants discussed. Reference is made to the operations of hot brass pressing and the impact extrusion of tin-lead alloy tubes.—J. C. C.

**The Manufacture of Silver Flatware and Hollow Ware.** Charles A. Rivard (*Met. Ind. (N. Y.)*, 1937, 35, (7), 340-343).—Stamping, spinning, assembling, plating, annealing, and finishing operations are described.—A. R. P.

**Intricate Details Feature Silverware Manufacture.** Fred B. Jacobs (*Abrasives*, 1937, 18, (8), 9-12; (9), 26-28, 59).—A brief account of the operations of casting, rolling, blanking, grading, and striking silver flatware in an American plant.—J. C. C.

**Phototube Controls Punch Press.** Ralph A. Powers (*Electronics*, 1937, 10, (7), 21-23).—A description is given of a photoelectric cell device for stopping the action of a fabricating press in the event of the hands or arms of its operator getting too near the press dies. Details are given of the electrical circuit and apparatus.—E. V. W.

**Production of Metallic Coatings by Powdering as a Means for Saving Metals.** E. Antoshin (*Machinostroitel (Machine Builder)*, 1937, (5), 12-14).—[In Russian.] Examples of how powdering may be used to reduce the consumption of non-ferrous metals.—N. A.

**The Production of Sintered Carbides.** — (*Machinery (Lond.)*, 1937, 50, (1301), 773-774).—A brief illustrated description of an American plant for producing sintered carbides. A mixture of tantalum and titanium carbides with powdered cobalt is tumbled for some days; compressed at 4000 to 60,000 lb./in.<sup>2</sup>; heat-treated to produce a chalk-hard solid which can be machined to shape; packed with carbon powder in carbon boats; and sintered in a hydrogen atmosphere in a high-temperature furnace having a molybdenum-wound alundum heating tube.—J. C. C.

## XIX.—CLEANING AND FINISHING

(Continued from pp. 465-466.)

**Solvent Degreasing.** W. W. Davidson (*Electrochem. Soc. Preprint*, 1937, (Oct.), 217-228).—The solvent degreasing process for the removal of oil and grease from articles prior to electroplating or being otherwise "finished" is described in some detail. Fundamental principles of equipment design and the characteristics of the stabilized, non-inflammable solvents are discussed.

—S. G.

**Solvent Degreasing Prior to Electroplating.** A. H. Blake (*Monthly Rev. Amer. Electroplaters' Soc.*, 1937, 24, (3), 199-201).—The functions of the trichlorethylene vapour degreaser are briefly outlined.—A. R. P.

**Cleaning of Metals.** Walter R. Meyer (*Metals Handbook (Amer. Soc. Metals)*, 1936, 825-828).—Briefly discusses vapour degreasing, emulsifiable solvent cleaning, and aqueous alkaline cleaning.—S. G.

**Mechanical Methods for Cleaning Metals with Alkaline Solutions.** C. S. Tompkins (*Metals Handbook (Amer. Soc. Metals)*, 1936, 829-832).—S. G.

**Cleaning Metals by Blast Cleaning Process.** Victor F. Stine (*Metals Handbook (Amer. Soc. Metals)*, 1936, 841-842).—S. G.

**Tumbling, Rolling, and Barrel Burnishing.** R. W. Mitchell (*Metals Handbook (Amer. Soc. Metals)*, 1936, 846-853).—S. G.

**The Art of Metal Cleaning.** A. J. Round (*J. Electrodepositors' Tech. Soc.*, 1937, 12, 139-140; discussion, 140-142).—Suggestions are briefly made for cleaning rhodium, platinum, and gold plating; silver plating; nickel plating; chromium plating; cadmium, tin, zinc, and brass plating; and barrel plating.—S. G.

**Points to be Observed in the Setting up of a Pickling Shop.** — (*Giesserei-Praxis*, 1937, 58, (23/24), 234-236).—Discusses details in the construction of a pickling shop, such as the use of double doors between the pickling room and the plating room, use of acid-resistant paint for the walls and roof, use of non-inflammable trichlorethylene instead of benzine for degreasing. Details of the pickling process generally are also discussed.—J. H. W.

**General Remarks on the Pickling of Iron Prior to Hot-Dip Galvanizing.** H. Bablik (*Korrosion u. Metallschutz*, 1937, 13, (1/2), 34-40).—The subject is broadly discussed, with especial reference to the prevention of hydrogen embrittlement.—A. R. P.

**Films and Their Relation to Cleaning Before Electroplating.** C. Johnson (*Monthly Rev. Amer. Electroplaters' Soc.*, 1937, 24, (6), 520-522, 524-537).—The nature of various types of films which are formed on metals, and the mechanism of their removal, are discussed in the light of modern knowledge.—A. R. P.

**Control of Metal Finishing at the Ford Motor Company.** Haviland F. Reves (*Metal Cleaning and Finishing*, 1937, 9, (7), 559-566, 606).—Finishing processes at the works of the Ford Motor Co. are carefully controlled by frequent laboratory tests. Rust-proofing for all metal parts is described and takes the form of either metal coating (cadmium or zinc), phosphate coating, bonderising, or electrolytic or Granodizing processes. Every rust-proofed article is subjected to a drastic salt-spray test. Five types of production plating are used, viz. nickel, zinc, cadmium, chromium, and silver, and the various tests applied to the plated finish are described. Some of the varied methods of surface cleaning prior to plating, &c., are outlined. Special physical tests are used on selected parts, and the diffraction X-ray equipment is used to determine the character of plated metals. Details are also given of microscopic and spectrographic tests, and of a new testing machine, the Profilograph, which measures surface smoothness rather than the more commonly sought flatness.—I. J.

**Imitation Gold Finishes.** Charles W. Hardy (*Met. Ind. (N. Y.)*, 1937, 35, (3), 114-115).—A brass deposit resembling gold can be obtained from a bath containing copper cyanide 4, zinc cyanide 0.5, sodium cyanide 5, sodium carbonate 2, and Rochelle salt 2 oz. per (U.S.) gall. The bath is operated at 2-2.5 amp./ft.<sup>2</sup> at 35° C., using rolled 90 : 10 brass anodes.—A. R. P.

**The Nature of the Polish Layer on Metals.** Mervyn L. Smith (*Metal Cleaning and Finishing*, 1937, 9, (9), 783-787).—Modern views of the structure of the polish layer on metals are outlined, and examples given to show how the properties of this layer can be improved, especially as regards hardness and corrosion-resistance.—A. R. P.



**Electrolytic Polishing of Aluminium.** Hans Schmitt (*Aluminium*, 1937, 19, (6), 387-390; discussion, 395-397).—Anodic etching of aluminium in caustic soda solution containing various "restrainers," e.g. sodium sulphate, produces on the pure metal a lustrous, smooth, and highly reflecting surface, suitable for optical or heat-reflecting purposes. Good surfaces are obtained only when the metal is pure. Some practical hints for operating the process are given, and its uses are discussed.—A. R. P.

**Mechanical Surface Treatment of Aluminium and Its Alloys.** A. von Zeerleder and E. Zurbrügg (*Aluminium*, 1937, 19, (6), 366-371; discussion, 392-393).—Methods of producing scratch-brush and highly polished finishes on aluminium and Duralumin are described, and photomicrographs of characteristic surface finishes are reproduced. To obtain a good scratch-brush finish the metal must first be carefully degreased and, in the case of heat-treated alloys, the nitride film must be removed by pickling. Carborundum polishing discs are the best for removal of casting skin; a recommended polishing paste consists of a mixture of alumina 66, stearin 26, montan wax 6, and vaseline 2%.—A. R. P.

**Aluminium Polishing. The Plus Factor in Parts Value.** — (*Abrasives*, 1937, 18, (4), 9-11, 62).—Brief notes are given on the types of wheels and abrasives suitable for roughing, "oiling," buffing, and "colouring" aluminium sheet.—J. C. C.

**Monel Metal and Pure Nickel Require Careful Polishing.** W. F. Burchfield (*Abrasives*, 1937, 18, (6), 24-27, 57, 62).—The choice of wheels and abrasives for polishing Monel metal and nickel is briefly discussed.—J. C. C.

**Burnishing of Monel Metal and Pure Nickel.** W. F. Burchfield (*Abrasives*, 1937, 18, (7), 23, 63).—The use of brushes having wires of Monel metal and running at 3000 to 6000 ft./minute for producing bright, matte, and satin finishes on Monel metal and nickel is briefly discussed.—J. C. C.

**Grinding and Polishing in the Plating Industry.** Oskar Kramer (*Metallwaren.-Ind. u. Galvano-Tech.*, 1937, 35, (15), 314-316; (16), 336-339; (17), 357-359; (18), 381-382; (19), 402-403).—Various types of polishing powders, pastes, and wheels for the preparation of metals for plating, and for buffing the plated articles, are discussed.—A. R. P.

**Finishing Metal-Sprayed Coating.** Chas. Boyden (*Metallizer*, 1937, 5, (10), 4, 5).—Finishing can be carried out by wet grinding, dry grinding, or machining, preference being in the order given. A wheel surface speed of 6000 ft./minute is recommended for wet grinding, with the work speed at 60 to 80 ft./minute, and a traverse of up to 100 in./minute. Some notes are given on suitable tool post grinders. When machining metal-sprayed coatings, the tools should be ground as for machining cast iron, and finishing cuts should be very light with the work rotating slowly. When machining metal-sprayed bronze and similar alloys, slightly better results can be obtained if the bits are slightly dull, giving a slight burnishing effect.—W. E. B.

**Fundamentals of Metal Polishing.** W. Pettigrew (*Grits and Grinds*, 1937, 28, (1), 1-6).—The manufacture of polishing-wheels by rolling a glue-coated cloth wheel in a trough of abrasive is briefly described, and recommendations are tabulated for the grades of alundum most suitable for polishing operations on various materials. By using heavy rolling pressures and preheating wheel and abrasive, the abrasive packs better and needs less glue. Drying should be controlled so that 10-12% of moisture remains.—J. C. C.

**Properties of Fused Alumina Grain for Polishing.** A. A. Klein (*Monthly Rev. Amer. Electroplaters' Soc.*, 1937, 24, (5), 358-364).—The properties of alundum grain for polishing-wheels, and methods of testing them, are briefly described.—A. R. P.

**The Flexibility and Shape of Polishing Wheels and Their Relation to Performance.** R. L. Schwaeckerle (*Grits and Grinds*, 1937, 28, (1), 8-11).—It is

claimed that sheepskin, felt, canvas, or compress wheels formed to the shape of the part are more economical and produce a better finish than the flexible sewed buff wheels now widely used for polishing.—J. C. C.

**Metal Polishes.** Ralph H. Auch (*Soap*, 1936, 12, (5), 28; *Ceram. Abs.*, 1936, 15, 321).—Abrasives commonly used in metal polishes are tripoli, silica, diatomaceous earth, precipitated calcite, and colloidal clay; rottenstone, emery flour, pumice, putty powder, precipitated chalk, whiting, tin oxide, salt, aluminium oxide, fuller's earth, and rouge may also be used. In general, the only value of colloidal clay consists in its ability to hold active abrasives in suspension. Formulas are given which illustrate the particular suitability of abrasives for any particular type of polish.—S. G.

**The Flexibility and Shape of Polishing Wheels and Their Relation to Performance.** R. L. Schwaegerle (*Grits and Grinds*, 1937, 28, (1), 8-11; and *Met. Ind. (N.Y.)*, 1937, 35, (5), 228-229).—Suitable wheels for various buffing processes are briefly discussed.—A. R. P.

**Reducing the Cost of Milling Aluminium Castings.** J. E. Swanson (*Met. Ind. (N.Y.)*, 1937, 35, (6), 294-295).—New types of milling machines are described, with reference to diagrams.—A. R. P.

**Health Risks in the Finishing Trades.** E. R. A. Merewether (*J. Electrodepositors' Tech. Soc.*, 1937, 12, 143-154; discussion, 154-155).—M., who is one of H.M. Medical Inspectors of Factories, discusses: risks from machinery, electricity, fire, and explosion; risks from dusts; solvents; acids, alkalis, tarry products, and other liquids; fumes; and preventive measures.—S. G.

**Methods for Controlling the Dust Hazard.** A. D. Brandt (*Metal Cleaning and Finishing*, 1937, 9, (4), 281-288).—Damping and exhaust systems for removing dust-laden air from work involving the use of abrasives are discussed, and some modern types of respirators are described.—A. R. P.

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## XX.—JOINING

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(Continued from pp. 466-468.)

**Pneumatic Hammers for Duralumin Rivets.** — (*Aluminium and Non-Ferrous Rev.*, 1937, 2, (7), 246).—Brief descriptions are given of a high-speed hammer for closing Duralumin rivets up to  $\frac{5}{8}$  in. in diameter, a squeeze riveter for closing rivets of the same sizes by a single stroke, and a long-stroke, slow-hitting riveter for rivets from  $\frac{1}{8}$  to  $\frac{5}{8}$  in. in diameter.—J. C. C.

**Soldering (Soft Solders).** — (*Metals Handbook (Amer. Soc. Metals)*, 1936, 888-892).—Prepared by a sub-committee of the American Society for Metals. Discusses the use and application of the lead-tin and lead-tin-cadmium alloys, &c. Attention is devoted to varieties of metals which can be soldered, types of fluxes, and methods of application.—S. G.

**The Manufacture of Filled Soldering Wire.** Ralph W. Harbison (*Draht-Welt*, 1937, 30, (29), 355-358).—Soldering wire containing a core of flux ensures the correct proportion of the latter, whilst the metal of the wire is protected from oxidation. Methods of securing accuracy of bore and wall-thickness, uniformity of core, and good appearance of the product at an economic price are discussed, and the principle of the dies generally employed is illustrated. A plant utilizing two drawing machines is described. Suitable compositions are suggested for solder and flux.—P. R.

**Soldering of Lead in the Production and Repair of Chemical Apparatus.** A. M. Ginstling and G. D. Kanter (*Khimicheskoe Mashinostroenie (Chem. Machine Building)*, 1937, (1), 20-22).—[In Russian.] A description of the methods of soldering of lead sheets and tubes.—N. A.

**Brazing and Related Joining Methods.** — (*Metals Handbook (Amer. Soc. Metals)*, 1936, 893-898).—Prepared by a sub-committee of the American Society



for Metals. Discusses the preparation of the joint, methods of heating, types of brazing alloys, special processes, and fluxes. Tables give the melting points and compositions of special silver solders, brazing alloys, and copper alloy welding rods.—S. G.

**Brazed Joints for Electrical Connections.** William J. Hart (*Machinist (Eur. Edn.)*, 1937, 81, (33), 734-736).—Describes recent improvements in brazing practice, and recommends alloys of relatively low melting point for brazing electrical connections.—J. H. W.

**The Welding of Aluminium.** — (*Soudure et Oxy-Coupage*, 1937, 14, (77), 29-32).—Describes welded tanks, a heating coil, and an out-board speed-boat.—H. W. G. H.

**The Spot-Welding of Altmag.** A. S. Orlov (*Aviopromishlennost (Aeroplane Ind.)*, 1937, (1), 34-39).—[In Russian.] The AT 15 machine of the "Electric" works can be used for the spot-welding of Altmag (aluminium plus magnesium 5-8, manganese 0.5-1, titanium 0.1-0.5, iron < 0.5%, and silicon < 0.5%). If copper electrodes are used, the total thickness of the weld can be up to 3 mm., in which case the conditions of welding must be: diameter of electrode, 4 mm.; duration of the welding, 0.20 seconds; pressure on the electrode, 19.0-43.8 kg. The mean specific strength of the welded point is 14.6-18.5 kg./mm.<sup>2</sup>.—N. A.

**Spot-Welding and Seam-Welding the Aluminium Alloys.** G. O. Hoglund (*S.A.E. Journal*, 1937, 40, (2), 57-64; and *Machinist (Eur. Edn.)*, 1937, 81, (2), 17-21).—The potential economies in resistance-welding aluminium alloys have been realized to a limited extent, and such examples as petrol and water tanks for aircraft, flooring panels, aeroplane cowling and fittings, &c., have given satisfactory service. The elimination of rivet heads on external surfaces of aircraft reduces drag. The process is applicable to the assembly of almost any parts, in any alloy, with a section thickness less than  $\frac{3}{8}$  in. The welding machines used should be capable of delivering at least 24,000 amp. at the electrodes for welding  $\frac{1}{8}$  in. thick material; 33,000 amp. for  $\frac{1}{4}$  in. material; and 42,000 amp. for  $\frac{3}{8}$  in. material. Full electronic synchronous timing control is advisable for spot-welding, and essential for seam-welding. The oxide coating on most of the alloys must be removed before welding by scratch-brushing or etching. Electrodes should be made of alloys having over 75% the conductivity of pure copper. Correct adjustment of the current can be maintained by reading deflections on an ordinary ammeter connected to a current transformer on the primary circuit of the machine. Welds in the heat-treated alloys containing copper are less resistant to corrosion than the parent material, and should be protected by coatings.—H. W. G. H.

**Spot and Seam-Welding (Resistance) of Aluminium Alloy Sheet.** D. I. Bohn (*Metal Progress*, 1937, 32, (1), 53-56).—The special requirements for successful resistance-welding of light alloys are discussed and enumerated. Suitable water-cooled electrodes of hard copper alloy are available in various contours, and electrode pressure can be adjusted accurately and quickly by pneumatic controls. The relative merits and applications of power controls of the synchronous and non-synchronous types are considered, and approximate settings for spot-welding sheet of 10 standard gauges are given. The special characteristics of seam-welding work are discussed.—P. R.

**Large Aluminium Containers.** — (*Aluminium*, 1937, 19, (6), 398-401).—The construction of some large welded tanks for use in a soapworks as storage vessels holding up to 450 tons is described and discussed.—A. R. P.

**Aircraft Spot-Welding Efforts Benefit Many Industries.** Bruce Burns (*S.A.E. Journal*, 1937, 40, (3), 99-107; discussion, 107-110).—The requirements of the aircraft industry have necessitated investigations into the spot-welding of the strong aluminium alloys and the stainless steels, for which extremely close control of the welding time and current and the electrode

pressure is necessary. Welding machines have consequently been designed and built specifically for aircraft work, but the knowledge obtained will benefit many other industries. Further improvements in ease of control, flexibility, and adaptability of machines and in the properties of electrode materials, are needed.—H. W. G. H.

**The Gas-Welding of Cupro-Nickels and Copper-Silicon Alloys.** I. T. Hook (*Internat. Acet. Assoc. Proc.*, 1936, **37**, 26-37; discussion, 37-38).—For gas-welding cupro-nickel, a neutral flame is considered ideal, but a slight excess of acetylene is permissible to avoid any chance of oxidation. A small addition of silicon to the welding rod is said to cause the formation of a protective film on the weld pool, reducing oxidation, contamination, and the loss of deoxidizing and desulphurizing elements. A flux of borax and boric acid is found adequate. The copper-silicon alloys are welded with a slightly oxidizing flame and the need for rapidity in welding is stressed. A filler rod of same composition as the base metal, and a flux consisting of fused borax, boric acid, and 10% sodium fluoride are used. 21 references are given.—H. W. G. H.

**Turbine Runner Repaired.** — (*Oxy-Acetylene Tips*, 1937, **16**, (7), 157).—The repair of a cast bronze water-wheel is described and illustrated.—H. H.

**The Electric-Welding of Monel and Nickel.** F. G. Flocke and J. G. Schoener (*Trans. Amer. Soc. Mech. Eng.*, 1936, **58**, 541-546; *Welding Eng.*, 1936, **21**, (11), 30-34; and *Met. Ind. (Lond.)*, 1936, **49**, (24), 583-586).—Improved refining methods are said to have reduced the hot-shortness of nickel and Monel metal and, consequently, the tendency to crack during welding. Electrodes for the metallic arc process contain a small amount of aluminium in the core wire and produce welds of strength equal to the sheet material. The heavy-coated electrodes should be connected to the positive pole. Diagrams are given showing the relation between sheet thickness and current required. In carbon arc welding, the electrode should be connected to the negative pole and care be taken to prevent it becoming blunt.—H. W. G. H.

**Welding Nickel and Nickel Alloys.** Hideo Nishimura (*Japan Nickel Rev.*, 1937, **5**, (2), 158-171).—[In English and Japanese.] The effects of oxygen, carbon, and sulphur in the welding of nickel are explained, and the precautions required for successful oxy-acetylene, metallic arc, carbon arc, and resistance-welding are shown to depend on the avoidance of oxidation, gas absorption, and cracking due to hot-shortness. Outlines are given of the technique recommended in Great Britain and the U.S.A. The best results are said to be obtained, in gas-welding, by adding ethyl borate to the acetylene, and, in arc-welding, by using titanium-coated electrodes. The strength of the welds is given as between 90 and 95% of that of the annealed base metal.

—H. W. G. H.

**How to Cut Stainless-Clad and Nickel-Clad Steel Plate.** — (*Oxy-Acetylene Tips*, 1937, **16**, (7), 149-153).—The cutting should be carried out from the mild steel side, the nozzle being kept at an angle of 10° from the vertical, so that the flame points backwards. The preheating gas pressures are the same as for mild steel of similar thickness, but the cutting oxygen pressures are 50-100% higher. In the case of stainless-clad material, there is no pick-up of carbon at the edge of the stainless layer.—H. W. G. H.

**The Rightward Method of Oxy-Acetylene Welding.** — (*British Oxygen Co. (Booklet)*, 1937, 15 pp.; and *Aluminium and Non-Ferrous Rev.*, 1937, **2**, (7), 263-268).—The rightward method of welding is clearly described and its advantages discussed. The bevel required in butt-welding plates is less than in leftward welding, the heat is more localized, and the deposited metal is cooled more slowly.—J. C. C.

**Electric Welding.** Oskar Zdralek (*Elektrotech. Z.*, 1936, **57**, (40), 1148-1151).—The various methods of electric resistance and arc-welding, and their fields of application, are described.—B. Bl.



\***Half-Cycle Spot-Welder Control.** T. S. Gray and W. B. Nottingham (*Rev. Sci. Instruments*, 1937, [N.S.], 8, (2), 65–68).—An electric circuit is described for controlling a small spot-welder (1–3 kva.), using simple, inexpensive cold cathode tubes. Variation of the welding heat is effected by control of the fraction of a single half-cycle, during which current is supplied to the welder transformer.—J. S. G. T.

**Interrupted Spot-Welding Uses Electron Tube Control.** R. S. Pelton (*Metal Progress*, 1937, 32, (1), 59–62).—The accurate control required by certain welding operations can be obtained by the use of thyratron time controls. These permit greatly increased welding speeds, exactly regulate the duration of power application and the instant at which the current is applied, and reduce the control costs. The life of electrodes (especially of the water-cooled type) is increased. Timing recommendations are made for various types of section and for “projection” work.—P. R.

**Residual Strains and Stresses in Arc-Welded Plates.** H. E. Lance Martin (*Welding Ind.*, 1937, 5, (5), 163–166; (6), 202–207).—A sensitive comparator is described by which alterations of  $5 \times 10^{-6}$  in. in a 2-in. gauge-length can be measured. This is calibrated by an interference method, and used to determine the lateral and longitudinal strains after welding mild steel plates and after partial or complete relief of the residual stresses resulting from the welding. Three unrestricted edge welds were investigated, and one restricted V butt-weld of a design which, it is claimed, the results show to assess the suitability of electrodes, parent metals, the skill of the operator, and the quality of the welding procedure.—H. W. G. H.

**Welding of Metals.** — (*Metals Handbook (Amer. Soc. Metals)*, 1936, 102–127).—An article, prepared under the sponsorship of the International Acetylene Association, which covers principally the metallurgical aspects of the art of fusion welding and certain allied processes. The welding of ferrous materials, brass and bronze, aluminium and its alloys, and nickel and its alloys, are discussed. Stress relieving, bronze welding, bronze surfacing, hard facing, hard setting, the inspection and testing of welds, codes and specifications, safe practices in fusion welding, special precautions, and health protection are dealt with.—S. G.

**Hygiene and Safety of Welders by Blowpipe and Arc.** A. Leroy (*Rev. Soudure Autogène*, 1937, 29, (280), 147–149).—A long abstract from a paper presented at the Congrès de l'Association des Industriels de France contre les Accidents du Travail. The sources of noxious fumes are: the source of heat (flame or arc), the molten metal, the constituents of the flux, and dirt or coatings on the pieces to be joined. These are reviewed in turn, and it is concluded that, under conditions of good ventilation, none of them cause danger. In special cases, such as zinc oxide or lead fumes, respirators are recommended.

—H. W. G. H.

## XXI.—INDUSTRIAL USES AND APPLICATIONS

(Continued from pp. 468–471.)

**Aluminium and Aluminium Alloys in Machine and Apparatus Construction.** H. Schmitt and F. Reidemeister (*Maschinenbau*, 1937, 16, (11/12), 315–318).—The chemical and mechanical properties of the common aluminium alloys are reviewed, and many examples of the use of these alloys in industry are cited.—v. G.

\***The Development of the Construction of Cables and Their Standing in Overhead-Lines.** T. Gröbl and H. Glasser (*Elektrotech. Z.*, 1936, 57, (48), 1388–1399).—Experiences with stranded aluminium, steel-cored aluminium, and Aldrey cables for overhead conductors are described, and the effect of the

method of suspension on the corrosion-resistance and life of the cables has been investigated. A self-damping steel-aluminium conductor has been developed which is not subject to vibration fracture.—B. Bl.

**Greasing of Free Conductors [of Aluminium].** Paul Behrens (*Aluminium*, 1937, 19, (5), 318-321).—Stranded aluminium electric cables should be adequately greased with a neutral grease, such as Shell vaseline No. 856, each strand being greased separately. In the case of high tension cables with a steel core, the inside strands should be more heavily greased than the outside. Methods of applying a uniform grease coating are described.—A. P.

**\*The Design of Metal Fins for Air-Cooled Engines.** Arnold E. Biermann (*S.A.E. Journal*, 1937, 41, (3), 388-392).—The proportions of aluminium and steel fins, to dissipate maximum quantities of heat, were determined for several pressure differences across a finned cylinder. It was found that correctly proportioned aluminium fins will transfer more than  $2\frac{1}{2}$  times as much heat as steel fins for the same weight and pressure drop.—H. W. G. H.

**\*Monocoque Construction.** I. J. Gerard (*J. Roy. Aeronaut. Soc.*, 1937, 41, (318), 467-492).—The use of Duralumin sheet, strip, and tubes in the stressed-skin form of aircraft construction is discussed, and results of tests of specimens of different designs are given.—H. S.

**Road Vehicles of Light Metal—An Up-to-Date Inspection.** Heinz Brauer (*Aluminium*, 1937, 19, (5), 306-312).—The use of light metals for the construction of the chassis and coachwork of motor vehicles is discussed, with special reference to stress distribution.—A. R. P.

**Selection of High Strength Aluminium Alloys for Pistons.** A. M. Brezgunov (*Aviopromishlennost (Air Industry)*, 1937, (2), 38-42).—[In Russian.] A review.—N. A.

**Aluminium Pistons for the Automobile M 1.** A. M. Duhota (*Auto-traktorno Delo (Auto-Tractor Practice)*, 1937, (2), 52-58).—[In Russian.] A discussion of the advantages of aluminium pistons. The alloy used for the piston of the "M 1" model contains copper 10% and magnesium 0.25%, the rest being aluminium. The preparation of the alloy is described, and possible causes of failure, and means of avoiding them, are discussed. Thermal and mechanical treatments of the pistons are also described.—N. A.

**Light Metal Alloys for the Hot Parts of Combustion Motors.** P. Sommer (*Brennstoff-u.-Wärmewirt.*, 1937, 19, 85-90; *C. Abs.*, 1937, 31, 6170).—Pure aluminium has a thermal conductivity of 0.52 cal./cm./second/degree; all alloying materials decrease this value. Steel has a greater specific heat per unit volume than aluminium, while aluminium has a greater specific heat per unit of weight. Increasing the amount of silicon in aluminium-silicon alloys decreases the thermal expansion. A discussion of various aluminium alloys is given.—S. G.

**Light Metal Fire Helmets.** Helmuth Fischbach (*Aluminium*, 1937, 19, (6), 417-419).—Black lacquered, hard-worked, age-hardened aluminium alloy helmets for firemen are equal in strength and corrosion-resistance to steel helmets, and only  $\frac{1}{3}$  to  $\frac{1}{2}$  the weight. They have been adopted as standard in many German fire brigades.—A. R. P.

**Use of Aluminium Foil in Construction.** A. Korzhnev and P. Pshenizin (*Stroitel'naja Promishlennost (Building Ind.)*, 1937, (9), 42-43).—[In Russian.] A description of the applications of aluminium foil in the building industry.

—N. A.

**Aluminium a Possible Aid in Reducing Silicosis.** J. J. Denny, W. D. Robson, D. A. Irwin (*Eng. and Min. J.*, 1937, 138, (9), 47-50).—See *Met. Abs.*, this vol., p. 469.—R. Gr.

**Beryllium and Its Alloys.** L. Sanderson (*Sands, Clays, and Minerals*, 1937, 3, (2), 95-98).—A brief account is given of the occurrence, recovery, uses, and methods of determining beryllium.—A. R. P.



**Arsenic-Cadmium Babbitts.** A. M. Duhota (*Machinostroitel (Machine Builder)*, 1937, (8), 49-50).—[In Russian.] A study of the properties of arsenic-cadmium Babbitts shows the possibility of using them in place of the tin-base Babbitts.—N. A.

**Experiences with Heat Conductors [Resistance Elements] of Iron-Chromium-Aluminium Alloys at High Temperatures.** R. Rumier (*Elektrowärme*, 1937, 7, (4), 69-74).—The best bedding or backing material for use with Kanthal or Megapyr resistance heating elements up to 1200° C. is sillimanite, or a mixture of 91% of kaolin and 9% of magnesia. Coils of both alloys "grow" on prolonged heating at above 1300° C., and the resistance increases; a voltage "booster," capable of giving 20% increase in voltage when required, must therefore be included in the circuit. The performance of heating elements of these wires in pottery and glass furnaces, where they come into contact with alkaline fumes, is very satisfactory.—A. R. P.

**Copper for Bus-Bar Purposes.** — (*Copper Develop. Assoc. Publ.*, 1936, (22), 161 pp.).—See review, *Met. Abs.*, this vol., p. 574.—S. G.

**The Commercially Important Wrought Copper Alloys.** — (*Chase Brass and Copper Co.* [Brochure], 1936, 60 pp.).—Gives, in a handy form, details of fabrication properties, hardness and tensile properties and certain physical properties of various coppers, brasses, lead- and other special brasses, nickel-brasses, bronzes, and of some proprietary alloys of the firm's own manufacture. Tables are also given of the weights (B. and S. gauges 1 to 40) for various sizes of brass and copper sheet and strip, brass and bronze rods, brass and copper tubes and pipes, and weights and tolerances for copper water-tubes, and tolerances for sheet and strip, rod, wire, and tubes. Finally, there are tables of comparison of gauge systems (American or Brown and Sharpe, Birmingham or Stubs, Was'n and Moen, Imperial S.W.G., London or Old English and United States Standard), and of decimals and equivalents in fractions.—S. G.

**The Use of Metals in the Papermaking Industry.** F. W. Tomlinson (*World's Paper Trade Rev.*, 1937, 107, 1053-1056, 1090, 1092, 1130, 1133, 1167-1168, 1200, 1202, 1240, 1242, 1272, 1274, 1312; *C. Abs.*, 1937, 31, 6876).—A review of metals for the paper-making industry, covering the various classes of copper-rich alloys, and outlining such of their properties as may be considered to concern the paper-mill equipment manufacturer or paper-maker when old materials are replaced or new materials are selected.—S. G.

**Substitution of Brass with 62% Copper for Brass with 68% Copper (L 68) in the Manufacture of Radiator Tubes.** A. M. Duhota (*Metallurgy (Metallurgist)*, 1937, (5), 127-129).—[In Russian.] Radiator tubes were made from L 62 (62% copper) and tested. The results indicate the possible substitution of "L 62" for "L 68" in the production of these tubes.—N. A.

**Lead: New Uses in Industry.** A. P. Knapp and R. T. Jaeger (*Chem. Industries*, 1937, 41, (1), 34, 36).—The lead lining of large conduit pipes for carrying gases containing sulphur dioxide is briefly described.—A. R. P.

**Nickel Alloys: Various Types and Uses in Chemical Operations.** Robert J. McKay (*Chem. Industries*, 1937, 41, (2), 131-133).—The uses of nickel, Monel metal, "K" Monel, and nickel-bearing cast iron in the construction of chemical apparatus are reviewed.—A. R. P.

**Nickel Alloys for Dairy Equipment.** Masaru Yamaguchi (*Japan Nickel Rev.*, 1937, 5, (3), 283-308).—[In English and Japanese.] Corrosion of metals by milk is shown to depend on the formation of surface films on the metal, and the oxygen content, temperature, degree of agitation, and acidity of the milk. Tables and curves are given to illustrate the effects of these factors in the case of nickel and Inconel. The former is found unsuitable for such applications as regenerative coolers, or with high acid dairy products, but can be used for heaters, storage, and transport tanks, and most pipe-lines. Inconel is suitable

for all applications. Tables are given showing the results of tests made by exposing samples under operating conditions.—H. W. G. H.

**Nickel Alloys in Food Processing Equipment.** Takashi Okamoto (*Japan Nickel Rev.*, 1937, 5, (3), 309-341).—[In English and Japanese.] Corrosion tests, made under operating conditions in a pea-canning plant, showed that for most metals corrosion was severest in the brine tanks and that, under these conditions, Monel metal and nickel showed the greatest resistance. Nickel, up to 80 p.p.m., had no effect on the colour or taste of peas. In a corn-canning plant also corrosion was severest in the brine tanks and Monel and nickel were resistant. In a tomato-processing plant, Monel was found to be more resistant than nickel. Among the other applications considered are: Monel separators for pea grading, Monel equipment for salt refining and wire mesh for conveyors, Monel driers, mixers and strainers, nickel jacketed kettles and heating coils, and many other items in both metals. 18:8 steel and Ni-resist are also considered.—H. W. G. H.

**Nickel and Its Alloys in the Brewing Industry.** Hideji Okuda (*Japan Nickel Rev.*, 1937, 5, (3), 342-354).—[In English and Japanese.] Nickel is said to be used for fermenters; storage tanks; yeast filters, troughs, sieves, and vats; cooling troughs; heating and cooling coils; piping; and jacketed kettles: Monel metal, for pipe lines; wort coolers; beer coolers; filters; valves, shafts, &c.: nickel-clad steel, for fermenters; storage tanks; covers for mash-tuns; cooler troughs; and yeast equipment. Inconel, 18:8, nickel, and Monel are recommended for use in wineries.—H. W. G. H.

**Nickel Alloys in Hotels, Restaurants, Ships, Hospitals, and Homes.** — (*Japan Nickel Rev.*, 1937, 5, (3), 355-363).—[In English and Japanese.] Nickel is recommended for cooking utensils, Monel for sinks, table tops, &c., and nickel silver for table-ware and fittings.—W. H. G. H.

**Nickel and Its Alloys in the Production and Distribution of Gas.** — (*Rev. Nickel*, 1937, 8, (2), 38-45).—In addition to the use of nickel cast irons in coking plants, applications of nickel and its alloys in gas-works include Monel metal for piping, pumps, and centrifugal extractors handling ammonium sulphate and other by-products; and nickel and Monel metal for orifices, valves, and other parts of measuring equipment.—J. C. C.

**The Pitting of Crucibles in Duferrite Salt Baths.** [Use of Chromium-Nickel Alloys.] C. Albrecht (*Durferrit-Mitt.*, 1935, 4, (10), 81-88; *Chem. Zentr.*, 1936, 107, (I), 2622).—A. discusses the question of materials and methods of control for the purpose of preventing excess crucible corrosion by CN-containing salt baths. Scale-resistant chromium-nickel alloys which, if necessary, may be alloyed also with aluminium and silicon (in which case the nickel content must be very high), are recommended as crucible materials. Methods of operation are also discussed.—S. G.

**Welded Salt Washer of Monel Metal in a Salt Refinery.** Rud. Müller (*Chem. Apparatur*, 1937, 24, (18), 300-301).—Aluminium washers give a grey, steel a reddish-brown, and Monel metal a beautiful white product; modern salt refineries therefore construct their wire sieves, centrifuges, filter-cloths, &c., of Monel, which is the only common alloy which is not attacked by brine at 150° C. Joints are made by electrical welding.—A. R. P.

**Tinplate in High-Speed Can Manufacture.** Graham C. Clark (*Swansea Tech. Coll. Met. Soc. Papers*, 1935, (Mar. 16), 21 pp.).—S. G.

**Sheet Steel and Tinplate as a Raw Material.** A. L. Stuchberry (*Swansea Tech. Coll. Met. Soc. Papers*, 1936, (Feb. 22), 15 pp.).—S. G.

**Bearing Metal in the Transport Industry.** H. N. Bassett (*Chem. and Ind.*, 1937, 56, (1), 9-11).—A practical review of the functions of bearing metals, and of the uses and relative properties of the alloys employed. The theories regarding the structure desirable in a bearing are briefly discussed, and reference is made to the recent tests in America, in which pure lead and pure



tin gave good results. Both theories are considered correct when properly applied; the pure metal bearings work well only in thin linings. Strength of the bearing metal is generally of less importance than good bonding to the shell. Copper-lead alloys and cadmium-base bearing metals are discussed. For railway work the present tin- and lead-base alloys will probably not be displaced, but for internal combustion engines the newer types of alloy may find increasing use.—R. G.

**White Metallizing Bearings.** A. E. Peters (*Machinist (Eur. Edn.)*, 1937, 81, (32), 438E).—A short article. In the case where oxy-acetylene flame apparatus is not available, it is far more economical and equally efficient, when white-metallizing bearings, to smoke the mandrel from a coal-gas flame, or to give it a coat of lamp-black, than to hold it in a paraffin blow-lamp flame.—J. H. W.

**Manufacture of Babbitted Steel Ribbon for Thin-Walled Bearings.** S. O. Kazman (*Auto-traktorno Delo (Auto-Tractor Practice)*, 1937, (1), 13-19).—[In Russian.] A discussion of: the specification of the steel ribbon; the tinning process and its failures; the application of the electrolytic method of tin plating; methods of Babbitting; and the melting of Babbitt and its composition (tin 90, antimony 3, and copper 7%). The conditions of Babbitting are: temperature of the ribbon 150°-200° C., temperature of the die 350°-400° C., and that of Babbitt 390°-400° C. Methods of testing for adhesion are also described.—N. A.

**How to Reduce the Consumption of Tin in Soldering and Tinning.** N. Ipatov (*Auto-traktornoe Delo (Auto-Tractor Practice)*, 1937, (3), 82-87).—[In Russian.] A report on investigations carried out in the Cheljabinsk Tractor Works on the possibility of reducing the consumption of tin in the processes of soldering and tinning.—N. A.

**The Properties of Modern Pewter.** — (*Engineering*, 1937, 144, (3738), 269-270).—After a short review of the development of pewter, reference is made to the results of research given in *Tech. Publ. Internat. Tin Res. Develop. Council, Series A*, 1937, (53), ; see *Met. Abs.*, this vol., p. 435.—R. Gr.

**\*Metal-Sprayed Surfaces in Relation to Lubrication.** Harry Shaw (*Assoc. Metal Sprayers, [Paper]*, 1937, (Oct.), 16 pp.; and *Met. Ind. (Lond.)*, 1937, 51, (18), 427-430).—The frictional and load-carrying properties of metal-sprayed steel shafts sprayed with steel and running in white-metal bearings, are investigated by means of the friction-testing machine known as the Shaw Frictiograph. Tests were run at different speeds, namely 445, 261, and 27 ft./minute, under various loads, using straight mineral oils, and alternatively oils containing 0.2% of colloidal graphite. At the highest speed it was found that the sprayed steel shaft would carry four times the load which is carried by an ordinary shaft. The coeff. of friction of the sprayed steel was always lower than that of ordinary steel in amounts varying from 5 to 30%. These tests were continued to find out the effect of the sprayed steel shaft after the oil had been cut off. The sprayed steel shaft was found to run 2½ hrs. after the oil supply had been discontinued, while the ordinary shaft seized after 3 hrs. Tests were then carried out in 22 different engines, running under normal conditions, from 5 private cars, 4 commercial vehicles, 5 petrol buses, and 8 diesel buses. It was found that the wear on the sprayed steel crankshafts was very much less than on those of ordinary steel, and that the wear on the white-metal bearing was also very much less. S. describes some of the theories of lubrication, and an investigation into the surface roughness of various finishes on steel, and sprayed steel, as measured by the Shaw Contorograph. From the experiments, it is concluded that the matte surface which is given by sprayed steel is ideal for the maintenance of an oil film. S. states that the use of two sprayed surfaces working against one another is satisfactory, and that sprayed bronze has been shown to be perfectly satisfactory as a bearing metal. Insufficient data have yet been collected to give any recommendation as to the use of sprayed white-metal, but this work is being continued.—W. E. B.

**Wear of Metallic Surfaces.** E. E. LeVan (*Metals and Alloys*, 1937, 8, (7), 206-209).—The use of hard carbide alloys and of Stellite-like alloys for coating the wearing surfaces of valve seats, oil-well drills, &c., is discussed.

—A. R. P.

**Cemented or Sintered Hard Carbides.** A. MacKenzie (*Metals Handbook (Amer. Soc. Metals)*, 1936, 772-780).—A review, dealing with pressing, forming, and sintering, and properties and applications.—S. G.

**The Uses of Hard Metal Tools in the Chemical Industry.** Karl Becker (*Chem. Apparatur*, 1937, 24, (3), 33-35).—Various types of tipped cutting tools are described, as well as methods of fixing the hard metal tip. The most suitable cutting angles for various operations are also discussed.—A. R. P.

**Zinc Die-Cast Alloys. A Comparison of Zinc Die-Cast Alloys with Brass Pressure Castings.** E. T. Richards (*Giesserei-Praxis*, 1937, 58, (27/28), 273-275).—The chief disadvantages of die-cast alloys were originally their sensitiveness to high temperatures, their tendency to form hair cracks, and to intercrystalline oxidation, which greatly diminishes the tensile strength, and their alteration of dimensions by heat and other causes. These disadvantages were due largely to the presence of impurities to a greater degree than in modern alloys, especially to lead, tin, and cadmium, although these are now added intentionally in controlled amounts, e.g. lead up to 3%. According to DIN 1743, zinc die-casting alloys are divided into three groups: (1) copper-rich alloys containing 91-94% of zinc of 99.99% purity, aluminium 3.5-5, copper 2.5-4%; (2) low copper alloys containing zinc 93.4-95.75, aluminium 3.5-4.1, copper 0.75-2.5%; (3) alloys containing zinc 95.9-96.5, aluminium 3.5-4.1%. Details of these alloys and a comparison of their properties with those of brass pressure castings are given.—J. H. W.

**Die-Castings for Automotive Parts.** C. R. Maxon (*S.A.E. Journal*, 1937, 41, (1), 293-302, 314; also *Met. Ind. (Lond.)*, 1937, 50, (20), 551-554; and *Met. Ind. (N.Y.)*, 1937, 35, (4), 151-159).—The advantages of zinc-base die-castings are said to be adaptability to rapid production at moderate cost, to complex shapes of close dimensional tolerance and of thin section, reduced need for polishing before plating, ease of machining if any is required, comparatively good resistance to corrosion, good physical properties, and low die cost on account of low casting temperatures. The alloys are not suitable for use at temperatures much above or below normal. Applications to radiator grilles, steering-wheels, interior fittings, window-frames, horns, &c., are reviewed, some finishing processes are described, and suggestions for design are given.—H. W. G. H.

**Die-Castings: Their Use in the Manufacture of Electrical Products.** H. Chase (*Elect. Rev.*, 1937, 121, (3118), 273-274).—Examples of the use of aluminium and zinc alloy die-castings for small electric motor housings, radio castings, and domestic appliances are briefly described.—J. C. C.

**Die-Casting and the Electrical Industry.** A. C. Street (*Elect. Times*, 1937, 92, (2395), 365-366).—A brief account of the characteristics of die-castings from zinc- and aluminium-base alloys, with some notes on their design. Pure metals offer difficulties in die-casting, but pure aluminium has been used successfully for die-casting conductors in position on an electric rotor frame. The frame, used as an insert in the mould, prevents the aluminium from cracking during solidification.—J. C. C.

**The Rational Allocation of the Employment of Materials in Respect of Their Uses.** R. de Fleury (*Congrès Internat. Fonderie, Paris (Preprint)*, 1937, 4 pp.).—[In French.] The factors to be considered, in choosing suitable materials for given applications, are divided into three categories: those influencing economic fabrication, the properties which the application demands, and considerations of economic transport, export, &c. These factors are analyzed, and concrete examples of their importance are given.—H. W. G. H.



**The Influence of Service Conditions on Metal Components of Industrial Plant.** J. Neill Greenwood (*Soc. Chem. Ind. Victoria [Proc.]*, 1936, 36, (6/9), 1174-1181).—The effects of structure of the metal or alloy, chemical and electrochemical action, and steady or fluctuating stresses and temperatures on the behaviour of constructional metal materials in industrial plant are broadly discussed.—A. R. P.

**Suitable Metals for the Food Industry.** James A. Rabbitt (*Japan Nickel Rev.*, 1937, 5, (3), 270-282).—[In English and Japanese.] Food production in Japan is analyzed and statistics given. The fact that nickel salts absorbed by foodstuffs are physiologically harmless is emphasized, and the applications of nickel, Monel metal, Inconel, and stainless steel in food industries are described, particular reference being made to appearance, ease of cleaning, freedom from corrosion and toxicity, and retention of flavour of the food.—H. W. G. H.

†**Present Tendencies in Water Turbine Machinery.** A. A. Fulton (*Proc. Inst. Mech. Eng.*, 1937, 135, 387-421; discussion, 422-444).—A description of the present state of knowledge, and details of design of Francis turbines and Pelton turbines. The problem of cavitation is discussed; it is becoming just as usual with Francis turbines as with Kaplan turbines to use stainless steel for the runners, because of the ability of this material to withstand cavitation effects. Occasional reference is made to the metals and alloys used for different parts and also to welding and other joining problems.

—W. H. R.

**Resistant Metals. Economy or Cheapness.** C. R. Vincent (*Indust. and Eng. Chem.*, 1937, 29, (4), 389-393).—A general discussion of the special applications of metals and alloys having superiority over steel in resistance to corrosion, elevated temperatures, scaling, contamination, abrasion, &c. Pure nickel, Monel metal, chromium alloys, combinations of chromium, nickel, copper, aluminium, manganese, tantalum, silver, vanadium, &c., afford such resistance and make for economies in first costs and/or tremendous savings during operation—the former by virtue of lesser weights and simplified construction details, the latter through longer life, decreased maintenance, freedom from contamination, process procedures not otherwise possible, increased efficiencies, &c. Resistance to high temperature, corrosion, and pressure are often simultaneously required. Price factors and welding possibilities are discussed. Alloy tanks, tank liners, and other forms of equipment are described and illustrated.—F. J.

**Metals Used in the Development of Power Cables.** W. H. Bassett, Jr. (*Metals and Alloys*, 1937, 8, (7), 185-190).—The preparation of copper wire from "Lake" copper bars, and of lead alloy sheathing by casting and extrusion is described.—A. R. P.

**Manufacturing and Assembling Radio Instruments.** Francis A. Westbrook (*Met. Ind. (N.Y.)*, 1937, 35, (3), 97-101).—An illustrated description is given of the manufacture of silver switch contacts, air condensers, lacquered aluminium panels, brass oscillator shelves, and copper linings for radio cabinets.—A. R. P.

## XXII.—MISCELLANEOUS

(Continued from pp. 472-473.)

**Henry Le Chatelier.** A. A. Baikov (*Metallurg (Metallurgist)*, 1937, (1), 3-8).—[In Russian.] Obituary notice.—N. A.

**Henry Le Chatelier (1850-1936).** René Dubrisay (*J. École polytech.*, 1937, [iii], 143, (1), 1-8).—S. G.

†**Non-Ferrous Metals.** A. R. Powell (*Rep. Prog. Applied Chem.*, 1936, 21, 363-383).—This comprehensive and, as usual, very readable annual review of the progress of non-ferrous metallurgy mentions, for 1936, 144 literature

references in the fields of ore dressing and extraction; production, refining, and casting; properties of metals and alloys; hardening and constitution of alloys; and corrosion and protection.—J. C. C.

**How Did the Metals Get Their Names?** Th. Wolff (*Draht-Welt*, 1937, 30, (16), 187–189; (17), 199–201).—The derivation of the names of several of the metals is discussed; in the case of some recently discovered elements an account of the circumstances of the discovery is also given.—P. R.

**The Aluminium Industry.** Junius D. Edwards (*Metals Handbook (Amer. Soc. Metals)*, 1936, 902–904).—Briefly discusses the occurrence, refining, and extraction of the metal, and the uses of the metal and its alloys.—S. G.

**The Rôle of Technical Information in Industrial Research and Development.** C. E. Homer and E. S. Hedges (*Comm. Congrès Mondial Document. Univ., Paris, 1937*, 177–180; and *Misc. Publ. Internat. Tin Res. Develop. Council, 1937*, (6), 9 pp.).—Briefly discusses the functions of industrial research and development organizations, and the scope, collection and storage, and distribution of technical information.—S. G.

\*[Report of the] **Department of Metallurgy and Metallurgical Chemistry [of the National Physical Laboratory].** C. H. Desch (*Nat. Phys. Lab. Rep.*, 1936, 94–100).—During 1936, work on standardizing Seger cones (Nos. 26–35) has been begun. Iron of the highest attainable purity is being prepared by decomposition of ferrous chloride by steam followed by reduction in hydrogen. Progress has been made in the X-ray study of iron-manganese alloys near the iron end of the series; the iron-nickel alloys are being re-investigated on account of great discrepancies in the results of previous workers; the iron-carbon system has been studied as far as 1% of carbon. Light magnesium alloys having a higher proof stress than magnesium alloys previously used, and suitable for use below 150° C., are now being produced industrially; a suitable composition is aluminium 8, silver 2.5, manganese 0.4, calcium 0.2, magnesium 88.9%. A magnesium alloy containing 10% cerium and 1.5% each of cobalt and manganese retains its comparatively great strength at 300° C. Work is in progress on the ternary system magnesium-aluminium-silver; the age-hardening properties of aluminium alloys are being studied. The mechanical properties of "Y"-alloy, L 5-alloy, and 4% copper-aluminium alloy are little affected by addition of titanium up to 0.2%, but the grain is refined and casting properties are improved. No improvement of intercrystalline corrosion in E-alloy (an alloy containing aluminium, copper, and zinc) is obtained by using, in the alloy, the aluminium and zinc of greater purity now available. The behaviour of steels and cast iron under stress at high temperatures is being studied; the research on the cracking of boiler plates due to exposure to caustic solutions has almost reached the report stage. The automatic potentiometer, used for taking thermal curves, and subsidiary apparatus used therewith have been improved so that the risk of overlooking small arrests is now reduced. An accurate method has been devised for the chemical analysis of calcium-magnesium alloys containing other metals.—J. S. G. T.

\*[Report of the] **Engineering Department [of the National Physical Laboratory].** H. J. Gough (*Nat. Phys. Lab. Rep.*, 1936, 78–93).—New researches commenced during 1936 include: data for the rational design of high-duty crankshafts for aeroplane engines (this research necessitates the investigation of effects due to alternating bending couples and torsional couples, static bending and twisting moments); the fatigue resistance of steels (full-scale fatigue tests are being carried out on eye-bolts for lift suspension). A definite stage has been reached in long-range research into fundamental aspects of the deformation and fracture of metals (the influence of boundaries on slip-band distribution is extremely slight; deformation follows very closely the max. resolved shear stress law, calculated for each



crystal as if it alone occupied the whole specimen; whatever the type of stress, deformation is identical, and a common condition marks the fracture stage; failure occurs by progressive breakdown of the grain to a limiting size of crystallite, viz.  $10^{-1}$  to  $10^{-3}$  cm.); corrosion-fatigue failure results principally from attack on cold-worked areas on the site of slip-bands; almost complete protection can be given by certain coatings to certain materials of low intrinsic resistance to corrosion; certain bronzes have fatigue corrosion-resistances of the same order as "corrosion-resistant" steels; the research into wear of metals has reached the first report stage; creep phenomena have been studied; tests have been made on the susceptibility of bolt materials to embrittlement on prolonged heating.—J. S. G. T.

\*[Report of the] Physics Department [of the National Physical Laboratory]. G. W. C. Kaye (*Nat. Phys. Lab. Rep.*, 1936, 15–38).—Work undertaken during the year includes: the measurement of the thermal conductivities of alloy steels up to  $800^{\circ}$  C., and of refractories; measurement of the latent heats of fusion ( $L$ ), and heats of transformation, ( $F$ ), of metals (provisional values of  $L$  and  $F$  for aluminium are  $L = 83$  cal./gram.;  $F = 9$  cal./gram.); heats of transformation of steels; the checking of pyrometers (two types of tungsten strip lamps are recommended for checking optical pyrometers over the working range  $700^{\circ}$ – $2500^{\circ}$  C.); the production of fibre structure in metals by extensive cold-work (it has been shown by X-ray analysis that the process is preceded by a breaking up of the crystals followed by distortion of the resultant grains; the hardness of brass, nitrided and tungsten steel and electrodeposited metals has been shown to increase with increase of internal strain; the magnetic quality of tungsten steel improves with increase of lattice distortion; the electrical properties of constantan depend markedly on the degree of perfection of the crystal grains); fatigue failure has been investigated by X-rays (the application of cyclic stresses results firstly in a breakdown of crystal grains into a mosaic of linear dimensions  $10^{-1}$  cm., followed by increasing departure of orientation from the original orientation, and subsequently the production of a random orientation of distorted grains near the fatigue cracks). Other matters discussed include measurements of noise, the acoustics of buildings, the measurement of radiation, tests for protective glasses for welders (many protective goggles provide less protection than is obtainable and, probably, desirable).—J. S. G. T.

R.C.A.—Research and Development. — (*Electronics*, 1937, 10, (8), 1–16 of supplement).—The research and development activities of the Radio Corporation of America are described. Physical and electrical researches are dealt with mainly, only a short space being devoted to the value of metallurgy and chemistry to the Corporation.—E. V. W.

### XXIII.—BIBLIOGRAPHY

(Publications marked \* may be consulted in the Library.)

(Continued from pp. 473–479.)

- \*American Society for Testing Materials. *Year-Book*. Med. 8vo. Pp. 268. 1937. Philadelphia, Pa.: The Society, 260 S. Broad St.
- \*Bourgoin, Louis. *Cours de Chimie. Métaux*. (Publications de l'École Polytechnique de Montréal.) Med. 8vo. Pp. xxvii + 688, with 145 illustrations. 1937. Montreal: L'École polytechnique de Montréal, 1430 Rue St. Denis. (\$4.00.)
- \*Bristol, University of. *Calendar 1937–1938*. Demy 8vo. Pp. 387. 1937. Bristol: The University. (2s.)

- \*British Cast Iron Research Association. *Sixteenth Annual Report for the Year ending June 30th, 1937*. 8vo. Pp. 25. 1937. Birmingham: The Association, 21-23 St. Paul's Sq.
- \*British Columbia. *The Year-Book of the Engineering Profession in British Columbia*. Med. 8vo. Pp. 123. 1937. Vancouver, B.C.: Association of Professional Engineers.
- \*British Metal Corporation, Ltd. *Quarterly Statistics for the United Kingdom on Lead, Spelter, Copper, and Tin*. 1937. January to March, April to June. Sup. Roy. 8vo. 1937. London: The British Metal Corporation, Ltd.
- \*British Metal Corporation, Ltd. *Review of Base Metal Conditions. Data on the Non-Ferrous Metal Trades of the United Kingdom*. 4to. Pp. 14. 1937. London: The British Metal Corporation, 93 Gresham St., E.C.2.
- \*British Oxygen Company, Ltd. *The Rightward Method of Oxy-Acetylene Welding*.  $7\frac{1}{4} \times 9\frac{1}{2}$  in. Pp. 15, with 11 illustrations. [1937.] London: The Company, Thames House, Millbank, S.W.1. (Gratis.)  
[See *Met. Abs.*, this vol., p. 560.]
- \*British Standards Institution. *British Standard Method and Tables for Brinell Hardness Testing*. (No. 240.) Revised September 1937. Demy 8vo. Pp. 24. 1937. London: The Institution, 28 Victoria St., S.W.1. (2s. 2d. post free.)
- \*Burkhardt, Arthur. *Zink und seine Legierungen. Zusammenfassende Darstellung der Eigenschaften*. 2 Auflage. (Beiträge zur Wirtschaft und Technik der Metalle und ihre Legierungen. Heft 1.) 4to. Pp. 40, with 109 illustrations. 1937. Berlin: N.E.M.-Verlag. (R.M. 5.)
- \*Chemical Society (and Others). *Report of a Joint Committee of the Chemical Society, the Faraday Society, and the Physical Society on Symbols for Thermodynamical and Physico-Chemical Quantities and Conventions Relating to Their Use*. Sup. Roy. 8vo. Pp. 16. 1937. London: Chemical Society (Members of the 3 societies, 4d. post free; non-members, 6d. post free.)
- \*Clark, C. L., and A. E. White. *The Properties of Metals at Elevated Temperatures*. (Department of Engineering Research, University of Michigan, Ann Arbor. Engineering Research Bulletin No. 27.) Med. 8vo. Pp. vi + 100, with 39 illustrations. 1936. Ann Arbor, Mich.: Director, Department of Engineering Research, University of Michigan. (\$1.00.)  
[See *Met. Abs.*, this vol., p. 487.]
- \*Copper Development Association. *German Copper and Brass Welding Practice*. Original German Edition published 1936 as "Das Schweißen von Kupfer und Messing" by the Deutsches Kupfer Institut, Berlin. (C.D.A. Publication No. 27.) Med. 8vo. Pp. 52, with 62 illustrations. 1937. London: The Association, Thames House, Millbank, S.W.1. (Gratis.)
- \*Cuthbertson, J. W. *A Plane Bending Apparatus with Interferometer Strain Recorder for Metallurgical Investigations*. (Technical Publications of the International Tin Research and Development Council, Series A, No. 60.) Med. 8vo. Pp. 13, with 4 illustrations. 1937. London: International Tin Research and Development Council, 378 Strand, W.C.2.



- \***Déribéré, Maurice.** *Le titane et ses composés dans l'industrie.* 13 × 21 cm. Pp. iv + 154, with 9 illustrations. 1937. Paris: Dunod. (23 francs.)
- \***Desch, Cecil H.** *Metallography.* (Textbooks of Physical Chemistry. Edited by F. G. Donnan.) Fourth Edition (Revised and Enlarged). Demy 8vo. Pp. viii + 402, with 147 illustrations in the text and xvii plates. 1937. London: Longmans, Green and Co., Ltd. (21s. net.)
- \***Elfein, Max.** *Die thermische und elektrische Leitfähigkeit von Aluminium-Gusslegierungen unter besonderer Berücksichtigung selbstveredelnder Legierungen.* (Forschungsarbeiten über Metallkunde und Röntgen-metallographie, Folge 23.) Roy. 8vo. Pp. 63, with 24 illustrations. 1937. München: Carl Hanser Verlag. (R.M. 4.50; R.M. 3.38 to foreign purchasers.)
- \***Engineering.** *Who's Who in Engineering. A Biographical Dictionary of the Engineering Profession.* Editor: Winifred Scott Downs. Fourth Edition. Med. 8vo. Pp. liii + 1638. 1937. New York: Lewis Historical Publishing Co., Inc. (\$10.00.)
- \***Furness, J. W., and H. M. Meyer.** *Copper.* (United States Department of the Interior, Bureau of Mines. Minerals Year-Book, 1937, Part II.) Med. 8vo. Pp. 141-169. 1937. Washington, D.C.: Superintendent of Documents. (10 cents.)
- \***Griesheimer Autogen Verkaufs G.m.b.H.** *Die Autogen-Schweissung von Leichtmetallen.* Vierte Auflage. 15 × 21 cm. Pp. 35, with 25 illustrations. 1937. Frankfurt-a.-M.; Griesheimer Autogen Verkaufs G.m.b.H.
- \***Henderson, Chas. W., and J. P. Dunlop.** *Gold and Silver.* (United States Department of the Interior, Bureau of Mines. Minerals Year-Book, 1937, Part II.) Med. 8vo. Pp. 111-139. 1937. Washington, D.C.: Superintendent of Documents. (10 cents.)
- \***Henderson, Chas. W., and A. J. Martin.** *Gold, Silver, Copper, Lead, and Zinc in Colorado (Mine Report).* (United States Department of the Interior, Bureau of Mines. Minerals Year-Book, 1937, Part II.) Med. 8vo. Pp. 299-341. 1937. Washington, D.C.: Superintendent of Documents. (10 cents.)
- \***Hoare, W. E.** *Variation in Thickness of the Tin Coating on Tinplate, and Its Effect on Porosity.* (Technical Publications of the International Tin Research and Development Council, Series A, No. 59.) Demy 8vo. Pp. 22, with 21 illustrations. 1937. London: International Tin Research and Development Council, 378 Strand, W.C.2. (Gratis.)  
[Reprint of a paper read before the Iron and Steel Institute; see *Met. Abs.*, this vol., p. 396.]
- \***Homer, C. E., and E. S. Hedges.** *The Rôle of Technical Information in Industrial Research and Development.* (Miscellaneous Publications of the International Tin Research and Development Council, No. 6.) Med. 8vo. Pp. 9. 1937. London: International Tin Research and Development Council, 378 Strand, W.C.2. (Gratis.)  
[Reprint from *Comm. Congrès Mondial Document. Univ., Paris, 1937, 177-180*; see *Met. Abs.*, this vol., p. 568.]
- \***Institution of Structural Engineers.** *Year-Book and List of Members, Session 1937-1938* Demy 8vo. Pp. 176. 1937. London: The Institution, 10 Upper Belgrave St., S.W.1. (2s.)

- \*Jennings, Chas. H. *How to Weld 29 Metals*.  $5\frac{1}{2} \times 8\frac{1}{2}$  in. Pp. 103, illustrated. 1937. East Pittsburgh, Pa.: Westinghouse Electric & Mfg. Co., Department 5-N. (50 cents); London: Westinghouse Electric International Co., 2 Norfolk St., W.C.2. (3s.).
- Levasseur, A. *La protection des pièces contre la corrosion*. 1937. Paris: The Author, École Spéciale de Travaux Aéronautiques.
- \*van Liempt, J. A. M., und J. A. de Vriend. *Studien über das Verbrennungslicht einiger Metalle*. (Laboratoria N.V. Philips' Gloeilampenfabrieken, Eindhoven (Holland), Separaat 1176.) Demy 8vo. Pp. 126-128. 1937. Eindhoven: N.V. Philips' Gloeilampenfabrieken.  
[Reprinted from *Rec. trav. chim.*, 1937, 56, (1), 126-128; see *Met. Abs.*, 487.]
- \*van Liempt, J. A. M., und J. A. de Vriend. *Über das Verbrennungslicht von Al-Zn und Al-Cd-Legierungen*. (Laboratoria N.V. Philips' Gloeilampenfabrieken, Eindhoven (Holland), Separaat 1200.) Demy 8vo. Pp. 594-598. 1937. Eindhoven: N.V. Philips' Gloeilampenfabrieken.  
[Reprinted from *Rec. trav. chim.*, 1937, 56, (5), 594-598; see *Met. Abs.*, this vol., p. 328.]
- Losana, Luigi. *Metallurgia*. Pp. 464. 1937. Torino: V. Giorgio.
- \*Meller, Karl. *Arc Welding Handbook*. Translated by J. E. Webb Ginger. Cr. 8vo. Pp. xiv + 210, with 83 illustrations. 1937. London: Hutchinson. (8s. 6d.)
- \*Mellor, J. W. *A Comprehensive Treatise on Inorganic and Theoretical Chemistry*. Volume XVI.—*Pt and General Index*. Med. 8vo. Pp. x + 811, with 94 illustrations. 1937. London: Longmans, Green and Co., Ltd. (63s. net.)  
[This volume completes the series.]
- \*Merrill, Charles White, and H. M. Gaylord. *Gold, Silver, Copper, Lead, and Zinc in California (Mine Report)*. (United States Department of the Interior, Bureau of Mines. Minerals Year-Book, 1937, Part II.) Med. 8vo. Pp. 251-298. 1937. Washington, D.C.: Superintendent of Documents. (10 cents.)
- \*Miklósi, Cornel, and Constantin C. Teodorescu. *Procedeele Industriale de Sudură*. [Industrial Welding Methods.]  $16 \times 23$  cm. Volumul I. Pp. 226. Volumul II. Pp. 377. With 573 illustrations. 1936. Bucaresti: Institutul Român de Energie. (Vol. I, Lei 300; Vol. II, Lei 600; Vol. III (in preparation), Lei 300.)
- \*National Research Council of Japan. *Report*. Volume II, No. 5. April 1935-March 1936. Demy 8vo. Pp. 2 + 347-434. 1937. Tokyo: The Council, Imperial Academy House, Ueno Park.
- \*Neave, D. P. C. *Copper and Its Alloys in Automobile Design*. (C.D.A. Publication No. 28.) Pp. 33, with 5 illustrations. 1937. London: Copper Development Association, Thames House, Millbank, S.W.1. (Gratis.)  
[Read before the Institution of Automobile Engineers.]
- \*Pehrson, Elmer. *Zinc*. (United States Department of the Interior, Bureau of Mines. Minerals Year-Book, 1937, Part II.) Med. 8vo. Pp. 191-210. 1937. Washington, D.C.: Superintendent of Documents. (5 cents.)
- \*Schied, Max. *Aluminiumguss. Schwierigkeiten bei der Herstellung und Wege zur Beseitigung*. (Elsners Giesserei-Fachbücher, 6.) Pp. 79, with 50 illustrations. 1937. Berlin: Otto Elsner. (R.M. 1.50.)



- \*Schied, Max. Bearbeitet von. *Giesserei-Taschenbuch, 1937*. F'cap.8vo. Pp. 430. 1937. Berlin: Elsner. (M. 3.)
- \*Shaw, Harry. *Metal Sprayed Surfaces in Relation to Lubrication*. (Association of Metal Sprayers.) Demy 8vo. Pp. 16, illustrated. 1937. Dudley: Association of Metal Sprayers, Barclay's Bank Chambers.  
[See *Met. Abs.*, this vol., p. 505.]
- Snamenski, Alexander Pavlovitch. *Metalworkers' Handbook*. [In Russian.] Volumes I and II. Seventh Edition. Pp. viii + 976. 1937. Moscow and Leningrad: Onti. (Rbl. 18.50.)
- \*Société des Ingénieurs Soudeurs. *Principes constructifs et problèmes métallurgiques de la soudure*. Conférence faite par D. Rosenthal à la Société des Ingénieurs Soudeurs le 17 Juin, 1937. Suivie des interventions de N. T. Belaïow: "Le point de vue du métallographie"; de P. Pierard: "Le point de vue de l'aciériste dans les problèmes de soudure"; et de A. Portevin: "Problèmes posés et conclusions." Med. 8vo. Pp. 36, with 15 illustrations. 1937. Paris: Société des Ingénieurs Soudeurs, 32 Boulevard de la Chapelle (XVIII).
- \*Thorpe, Jocelyn Field, and M. A. Whiteley, assisted by eminent contributors. *Thorpe's Dictionary of Applied Chemistry*. Fourth Edition. Volume I. [A-Bixin.] Med. 8vo. Pp. xxvii + 703, illustrated. 1937. London: Longmans, Green and Co., Ltd. (63s. net.)
- \*Townsend, William S. B. *The Development of Sheet Metal Detail Fittings for Bench Fitters and Toolmakers, &c.* (Aeronautical Engineering Series—Ground Engineers.) Demy 8vo. Pp. v + 42, with 23 illustrations. 1937. London: Sir Isaac Pitman and Sons, Ltd. (2s. 6d. net.)
- \*Vogel, Rudolf. *Die heterogenen Gleichgewichte*. (Handbuch der Metallphysik. Unter Mitwirkung zahlreicher Fachgenossen. Herausgegeben von G. Masing. Band II.) 17 × 24 cm. Pp. xxiii + 737, with 491 illustrations. 1937. Leipzig: Akademische Verlagsgesellschaft m.b.H. (Br., R.M. 66; geb., R.M. 68; 25% discount to foreign purchasers.)
- \*Watt, Alexander. *Electroplating*. Based on "Electrometallurgy Practically Treated." Second Impression. Demy 8vo. Pp. viii + 184, with 14 illustrations. 1937. London: Technical Press, Ltd. (6s. net.)

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#### XXIV.—BOOK REVIEWS

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(Continued from pp. 479-480.)

Gmelin's *Handbuch der anorganischen Chemie*. Achte Auflage. Herausgegeben von der Deutschen Chemischen Gesellschaft. System-Nummer 35: Aluminium. Teil A, Lieferung 5. Sup. Roy. 8vo. Pp. 683-886, illustrated. 1937. Berlin. Verlag Chemie G.m.b.H. (Auslandspreis R.M. 24.75.)

This section of the *Handbuch* forms a continuation of Lieferung 4, which was reviewed in *Met. Abs.*, 1936, 3, 286. It deals with the alloys of aluminium with zinc, cadmium, mercury, the rare earths, titanium, tin, lead, vanadium, chromium, and many other elements. The treatment is extremely thorough, covering the preparation, constitution, chemical and physical properties of the alloys, and the information given is up to date, the literature having been reviewed up to April 1937.

It is again necessary to point out that the only ternary and more complex alloys described are those whose constituents are dealt with in this and the preceding volume. For example, whilst the alloys of aluminium with zinc and magnesium are described in full, there is no reference to the aluminium-copper-zinc alloys.—H. W. L. PHILLIPS.

**Leichtmetallkolben für Fahrzeugmotoren.** Von R. Krüger. 15 × 22 cm. Pp. viii + 140, with 140 illustrations. 1937. Berlin: R. C. Schmidt & Cie. (Lw., M. 6.50.)

So far as is possible within its limited compass, this book deals thoroughly with the preparation of light alloy pistons for internal combustion engines. After a brief description of the properties which an alloy must possess to render it suitable for this type of work, the author reviews the piston alloys now on the market in Europe and America. He then deals in some detail with the various types of piston now in use and concludes with a description of the methods followed in casting, machining, and fitting.

The book is well produced and well illustrated, and summarizes in a convenient form information which it is not easy to obtain elsewhere.—H. W. L. PHILLIPS.

**Copper for Bus-Bar Purposes.** (C.D.A. Publication, No. 22.) 6½ × 8½ in. Pp. vi + 161, with frontispiece and 29 illustrations in the text. 1936. London: Copper Development Association, Thames House, Millbank, S.W.1. (Limited free issue.)

This book, one of the excellent publications which are issued free by the Copper Development Association, is not only a valuable compendium of information for the manufacturer and the electrician user of bus bars; it contains much of interest to the general engineering or metallurgical reader, such as the sections dealing with the properties of copper, and dissipation of heat, from the point of view of electrical use. The readable style and clear arrangement are attractive. In addition to data tables, a bibliography is given, with a list of British Standard Specifications.—R. GENDERS.

**L'Oxydation du Magnésium à l'État Liquide.** Par Robert Delavault. 16 × 24 cm. Pp. 94, with 42 illustrations. 1936. Paris: Centre de Documentation Universitaire, Tournier et Constans, 5 Place de la Sorbonne, 5e. (20 francs.)

This small book describes an investigation carried out under the direction of Professor Pascal at the Sorbonne, which was undertaken in scientific collaboration with the French Air Ministry, and had reference to melting fluxes for use with magnesium. The work deals with the action of air and its constituent gases on magnesium and alloys, with the action of oxidation with halogens on magnesium, zinc, cadmium, aluminium, and some of their alloys, and with some passivation phenomena of magnesium in air. The main feature of the oxidation of magnesium is its commencement by the formation of globular protuberances of oxide. Aluminium behaved similarly in bromine and oxygen. By modification of the theory of Pilling and Bedworth, taking into account the surface changes involved in a liquid metal, the author has formed conclusions on which a technique for the manipulation of molten magnesium (melting and casting) without the use of flux or protective atmosphere has been established. This method is not described.

The results as a whole illustrate an interesting line of research on the rapid oxidation of metals.—R. GENDERS.

**Magnesium-Legierungen. Patentsammlung.** Von A. Grützner, unter Mitarbeit von G. Apel und C. Götze. Zugleich Anhang zu Magnesium. Teil A in Gmelins Handbuch der anorganischen Chemie. Achte völlig neu bearbeitete Auflage. Herausgegeben von der Deutschen Chemischen Gesellschaft. Sup. Roy. 8vo. Pp. viii + 192. 1937. Berlin. Verlag Chemie G.m.b.H. (R.M. 15.)

This volume forms an appendix to the previously published volume on magnesium in Gmelin's "Handbuch." It consists of a classified list of patents covering magnesium alloy compositions which have been registered prior to December 1936, and will be invaluable to patent agents, libraries, &c., but scarcely to the ordinary reader.—H. W. L. PHILLIPS.

**Gmelin's Handbuch der anorganischen Chemie.** 8 Auflage. Herausgegeben von der Deutschen Chemischen Gesellschaft. Sup. Roy. 8vo. System-Nummer 22.—Kalium. Lieferung 1, Pp. 1-246. 1936. Lieferung 2, Pp. 247-514, illustrated. 1937. Lieferung 3, Pp. 515-804, illustrated. 1937. Berlin: Verlag Chemie G.m.b.H. (Auslandspreis, Lief. 1, R.M. 28.50; Lief. 2, R.M. 31.50; Lief. 3, R.M. 10.50.)

These three sections dealing with potassium are compiled with that thoroughness that we have come to expect of Gmelin's "Handbuch." The arrangement is systematic and the



surveys of the literature are not only exhaustive but critical, while the references are right up to date. The volumes are so written that they can be consulted with advantage by those with only a slight knowledge of the German language.

The first section deals with the occurrence, production and properties (atomic, physical, ionic, electrochemical, &c.) of the metal, and commences the discussion of the compounds, the oxide and hydroxide being dealt with. The second section deals with the compounds with nitrogen, fluorine, and chlorine, while the third section deals with the compounds with bromine, iodine, sulphur, selenium, and tellurium.

Like their predecessors, these books should be in every chemical and metallurgical reference library.

**The Science of Dental Materials.** By E. W. Skinner. Med. 8vo. Pp. 411, with 131 illustrations. 1936. London and Philadelphia: W. B. Saunders Co. (20s. net.)

One is accustomed to the fact that knowledge of one subject involves "dipping into" others correlated with it, but one cannot help being sorry for the dentist who, before he can adequately fill a tooth, has to master the contents of this excellent book: he needs must "plunge" rather than "dip" into the science of dental materials!

In introducing his subject the author points out the dentist's urgent need of a solid background in order to enable him to get full value out of the material with which he has to deal. The real significance of physical properties has been shown to be of immediate importance to dentists and, as a result, problems such as the determination of masticating stresses are shown to be capable of quantitative measurement. Also, it is fairly safe to say that most—if not all—the problems associated with dental materials have been considered and described in such detail that the dentist is given a very clear idea of the fundamental facts underlying his physical and chemical problems.

From the metallurgical point of view, Chapter XX and those following are of particular interest. The author has taken great pains to illustrate his subject matter with practical examples with which the dentist is familiar, and in so doing he brings home forcibly the real need for a sound knowledge of the science of metals. It is a little surprising, however, in describing the use of the optical pyrometer for high temperature measurements, that no mention is made of the need for black-body conditions. Also, in explaining the construction of the constitutional diagram, the author states that the solidus can be determined from the results of time-temperature curves, which method, however, is not generally considered satisfactory, particularly in those alloy systems where coring is marked. The few photomicrographs included in the text are unfortunately not in keeping with the standard of the book. Figs. 50, 51, 52 are scarcely intelligible for the uninitiated, since the structures are masked by the effect of bad polishing. There are, however, minor criticisms.

The all-important subject of amalgams has three chapters devoted to it, and has been dealt with in a clear and concise manner. Neither has the subject of steel and stainless steels, which is of growing importance to the dentist, been neglected, and much knowledge of practical value to the dentist has been included. The book ends with a chapter on gutta-percha, and an Appendix devoted to the American Dental Association's Specifications for Dental Materials.

The author is to be congratulated on the mastery with which he has dealt with a difficult subject, and for the clear manner by which he has shown the dentist the need for a sound basic knowledge of the science of metals.—M. L. V. GAYLER.

**Elasticity, Plasticity, and Structure of Matter.** By R. Houwink. With a Chapter on the Plasticity of Crystals by W. G. Burgers. Demy 8vo. Pp. xviii + 376, with 214 illustrations. 1937. London: Cambridge University Press. (21s. net.)

One of the purposes of this book is to bring physicists, chemists, and scientific technologists into closer contact with one another so that, by the aid of an insight into the structure of matter, they may seek to improve existing materials and to discover new ones; I quote, almost *verbatim*, from the foreword. Moreover, it is considered that in the study of the structure of materials and their behaviour on deformation lies the key to the deliberate synthesis of materials with definite desired elastic and plastic properties. I very much doubt it, for the infinite variables of nature are not to be found by solving a finite number of equations. Be that as it may, here the author reviews recent knowledge of the elastic, plastic, and structural characteristics of glasses, resins, asphalts, textiles, rubber, proteins, paints, clay, and sulphur. Dr. Burgers contributes an admirable chapter (42 pages) on the plasticity of crystals, which I commend to the attention of metallurgists. This chapter is a clear, well-reasoned and concise review of such matters as hardening on deformation, annealing, the mechanism of slip: in fact it reviews extremely well the part played by crystalline imperfections in the plastic behaviour of crystals. The rest of the book does not appear to me to keep up the high standard of this chapter; it attempts too much, and is often lacking in clearness and precision. It is interesting

to note that both contributors are members of the staff of N.V. Philips Gloeilampenfabrieken, Holland. The book is produced in the usual good style of the Cambridge University Press, and is sold at a reasonable price.—J. S. G. T.

**Technische Oberflächenkunde.** Von Gustav Schmaltz. 17 × 25 cm. Pp. xv + 286, with 395 illustrations. 1936. Berlin: Julius Springer. (Geh., R.M. 43.50; geb. R.M. 45.60; 25% discount to foreign purchasers.)

This book reviews the importance of the surfaces of materials of construction to mechanical engineers, to constructional engineers and to metallurgists; it gives in tabular form the limits of perfection obtainable in surfaces worked in various ways, e.g., by turning, planing, boring, lapping, polishing, &c. The author is anxious that engineers should accustom themselves to regard the surfaces of their constructional materials from the *three-dimensional* point of view. He directs attention to the significance of the internal transitional and external (adsorption) layers in metals, &c. Methods and appliances, largely originating in the author's own work, for the examination of the surfaces of materials before and after their erection into completed structures are described and illustrated.

It will be seen then that here is a book of first-class importance to metallurgists and engineers. It is the only one of just its kind that I have come across. Its price only will prevent it having the wide circulation it deserves. The author is an enthusiast for his subject—the science of technical surfaces. I commend to industrialists and technicians generally the author's dedication of this book, in part to his father, "who taught me that good machines are more important than money," and in part to his teacher "who taught me that one must ask of Science in many ways and oft before a useful reply is obtained." This book, evidently a labour of love by one who is both scientist and industrialist, is evidence that the lessons have borne much fruit.—J. S. G. THOMAS.

**Chemische Analysen-Methoden für Aluminium und Aluminium-Legierungen.** Bearbeiter: Chemiker-Fachausschuss der Aluminium-Zentrale unter der Obmannschaft von — Schall. 21 × 29.5 cm. Pp. 16. 1937. Berlin: Aluminium-Zentrale. (R.M. 3.)

The aim of this brochure is to give, in the most concise manner possible, methods for determining silicon, iron, copper, titanium, magnesium, manganese, and zinc in aluminium and its alloys. In many cases alternative methods are given. It is arranged on the loose-leaf system, each method taking a single page, and will be amplified in due course by the issue of pages covering later methods and other elements.

Each page gives an outline of the chemistry of the method, its scope, a list of the reagents and apparatus needed, working details, likely sources of error, and an estimate of the accuracy which should be attained and of the time necessary to carry out the analysis. The descriptions given, whilst necessarily brief, are sufficient to permit of the methods being followed satisfactorily by an experienced chemist. The methods are not, in all cases, those followed by other producers, and the accuracy claimed is insufficient for many purposes.—H. W. L. PHILLIPS.

**Lötmitel und Löten. Eine Zusammenstellung von Erfahrungen und Anweisungen über die praktische Lötarbeit.** Von E. J. Heynemann. 15 × 21 cm. (Bibliothek der gesamten Technik, Nr. 432.) Pp. iv + 48, with 23 illustrations. 1937. Leipzig: Max Jänecke. (M. 1.20; Auslandspreis, R.M. 0.90.)

The first two sections of this book, dealing with "soft" and "hard" soldering, give details of the alloys used as solders or brazing materials, the most suitable fluxes, and the technique of application. The third section is devoted to the soldering of aluminium and contains a warning concerning the poor corrosion-resistance of the joints. Special mention is made of jointing electrical conductors. The compositions of suitable solders are not given. The booklet is intended as an elementary treatise for the practical man, to whom it may be useful.

—H. W. G. HIGNETT.

**Procedeele Industriale de Sudură. (Industrial Welding Methods.)** By Cornel Miklósi and Constantin C. Teodorescu. Volumul I, Pp. 226. Volumul II, Pp. 377. With 573 illustrations. [Volumul III in preparation.] 1936. Bueuresti: Institutul Român de Energie. (Vol. I, Lei 300; Vol. II, Lei 600; Vol. III (in preparation), Lei 300.)

The first volume of this treatise on welding consists of a short review of the fundamental knowledge of metals and alloys. After a description of the constitutive elements of matter and definitions of the three physical states, the theory and analysis of crystals is explained, and definitions are given of polycrystalline metals, allotropic forms of substances and of solid



solutions, and of alloys. The mechanical properties of pure metals are then treated, these being divided into two classes: plastic and brittle. The testing methods are sketched. Recrystallization, internal stresses, the effect of temperature and of speed of deformation on mechanical properties are explained, and data on the physical properties of pure metals are given. The characteristic types of binary alloys and the methods of their preparation are described. Short chapters deal with: chemical compounds of metals, gases in metals, segregation on a large scale, and piping. The physical properties of alloys and the effect of heat-treatment and impurities are then discussed.

The second volume deals with the technology of welding. A rational and a practical classification of the welding methods are deduced, the latter being adopted as the basis of the treatise. After a short chapter on the fire-welding of metals, electric welding "by local heating" is dealt with, classified as: butt-welding (resistance-, spot-, shot-welding); spot-welding; seam-welding. The major part of the volume is reserved for fusion welding. The physical properties of the gases used in oxy-acetylene welding—oxygen, acetylene, hydrogen, methane, butane, town's gas, and benzene—are discussed, and gas generators, safety-valves, gas-cylinders, reducing valves, welding-torches, and the arrangement of welding shops are dealt with. Finally, the welding methods are discussed. The electric arc is then treated as another means of fusion-welding. An analysis of the production of the electric current for welding purposes, d.c. and a.c., is given, and the accessories and working methods are explained. Welding wires and electrodes are then considered. The apparatus, alloys, and fluxes used for soldering and brazing are dealt with, and a full explanation is given of the metallurgical phenomena in fusion-welding of carbon steels. The welding of special steels, cast-iron, copper, nickel, aluminium, and magnesium and their alloys, and of lead and zinc is described. The rest of the volume deals with the calculation of costs, applications of fusion-welding, gas-cutting, and aluminothermic welding.

The third volume, which is in preparation, will deal with normalizing, the resistance of welded constructions, the control of welding, and accident-prevention.

The volumes are well produced on good paper. A useful feature of the series is a 48-page bibliography which is included in Volume I.

**Der praktische Acetylen-Schweisser.** Von C. F. Keel. Herausgegeben vom Schweizer Acetylen-Verein, Basel. Dritte Auflage. Pp. 243, with 215 illustrations. 1937. Zürich: A.-G. Fachschriften-Verlag u. Buchdruckerei. (3.50 francs.)

This is the latest edition of a book which should be known to all interested in blowpipe-welding. It is written by an acknowledged authority on the subject, in an unpretentious style, which is most pleasant to read: very few words are wasted, and yet essential points are explained with painstaking thoroughness. The first five sections are devoted to descriptions of acetylene generators, blowpipes, &c., and to instructions in technique. As would be expected, such developments as rightward welding and welding with an oxidizing flame (for mild steel) are fully described. In the sixth section, consisting of 27 pages (of which 12 are completely occupied by illustrations), are to be found short notes on the welding of stainless steels and some non-ferrous metals. Those notes are of course inadequate, and the recommendation to use a filler rod, containing 1% phosphorus, for welding copper is to be regarded doubtfully. The last three sections deal with special applications of the blowpipe, welding calculations and tests, and a programme for a course of instruction in welding.

This book is to be most highly recommended to the practical man who wishes to extend his knowledge of welding: it is unfortunate that it is written in German.—H. W. G. HIGNETT.

**Electric Arc and Oxy-Acetylene Welding. A Practical Handbook for Works Managers, Welding Operators, and Students.** E. Arthur Atkins and A. G. Walker. Third Edition. Cr. 8vo. Pp. x + 394, with 178 illustrations. 1936. London: Sir Isaac Pitman and Sons, Ltd. (7s. 6d. net.)

The second edition of this book was reviewed in *Met. Abs.*, 1934, 1, 405, the criticism then being made that the text was not up to date. It is to be regretted that the same criticism must be made of the present edition, which, indeed, repeats the exact words of the earlier text and has, tacked on, a disjointed appendix, compiled mainly from manufacturers' catalogues. The reviewer escaped reading the first edition as published, but suspects he has done so unwittingly. Works managers and competent welding operators should be able to judge for themselves, but it is most unfair to convey to students such nonsense as, for example, "For a 3 in. length of joint [in  $\frac{1}{2}$  in. copper] . . . it is a good plan to start about 1 in. from the end . . ." (p. 116), or "Now in the enormously rapid heating up of the end of the electrode, the metal of the grain boundaries is first melted and, expanding quickly, tends to push off a crystal of the metal . . ." (p. 45). It is a sad reflection on the welding industry that such a book should have attained a third edition.—H. W. G. HIGNETT.

**Leçons Pratiques de Soudure à l'Arc.** Nouvelle édition. Pp. 56, with 92 illustrations. 1936. Bruxelles-Midi: Arcos, La Soudure électrique autogène S.A., 58-62, Rue des Deux-Gares. (2 francs.)

Twenty-two lessons are set forth in this booklet: they are all clearly described, excellently illustrated, and logically arranged. Although mild steel only is considered, and electrodes of a particular make are referred to, there can be few arc welders or teachers of welding who will not find something useful in this presentation of modern technique.—H. W. G. HIGNETT.

**Fertigungstechnik und Güte abbrenngeschweisster Verbindungen.** Von Hans Kilger. 15 × 21 cm. Pp. 128, with 75 illustrations. 1936. Braunschweig: Friedr. Vieweg u. Sohn. (R.M. 7.60.)

In this account of investigations into the variables of the flash-welding process, there is little of direct interest to the non-ferrous man, since all the test-welds were made in low-carbon steel. A larger number of fatigue, impact, bending, and tensile tests, on welds made under different conditions, show the predominating effect of soundness and cleanliness of the joint over other factors governing its properties. The effects of varying voltage and time on soundness and structure are demonstrated by one series of experiments, and the effects of the upsetting process by another. The booklet is to be recommended to all interested in the flash-welding process apart from its application to non-ferrous metals.—H. W. G. HIGNETT.

**Anleitungsblätter für das Schweißen im Maschinenbau.** Herausgegeben vom Fachausschuss für Schweißtechnik im Verein deutscher Ingenieure. 15 × 21 cm. Pp. iii + 52, with 82 illustrations. 1936. Berlin: V.D.I.-Verlag G.m.b.H. (R.M. 1; V.D.I.-Mitgl., R.M. 0.90.)

This booklet contains seven papers dealing with theoretical considerations underlying the design of welded constructions subject to alternating stress. These papers are of first importance to engineers, but they contain little of direct interest to the non-ferrous metallurgist.

—H. W. G. HIGNETT.

**Panel Beating and Sheet Metal Work.** By Sidney Pinder. Cr. 8vo. Pp. vii + 88, with 63 illustrations. 1937. London: Sir Isaac Pitman and Sons, Ltd. (4s. net.)

It is a great pity that writers of practical handbooks cannot restrain themselves from discussing matters concerning which they are abysmally ignorant. Human nature prevents fair judgment of the remainder of this book when one has had the painful experience of reading Chapter I—"Metals." In this, we read that the brittleness of metals is due to their crystalline nature, the main source of supply of bauxite for aluminium product is Larnie in Ireland, manganese bronze consists of 95% copper and 5% manganese, and phosphor bronze of 80% copper, 10% tin, 9.5% antimony, and 0.5% phosphorus. The other chapters explain how to make dents in, and knock them out of, metal sheets. They are not worth 4s.—H. W. G. HIGNETT.

**Comité Consultatif International Téléphonique (C.C.I.F.).** Proceedings of the Xth Plenary Meeting, Budapest, 3rd-10th September, 1934. Translated into English by the Technical Staff of the International Standard Electric Corporation. 28 × 22 cm. Pp. 660, illustrated. 1936. London: International Standard Electric Corp., 63 Aldwych, W.C.2. (25s.)

The outstanding work of the C.C.I.F. is in promoting and co-ordinating long distance telephone communication on an international scale. It is a consultative, rather than an executive, body which acts in an advisory capacity by making the experience and technique of each member administration available to the others. Its recommendations are prepared in its commissions of rapporteurs, made up of experts on questions relating to telephone transmission, the protection of telephone lines against external disturbances, and operating, maintenance, and rate problems. These recommendations are scrutinized and approved at the plenary meetings of the entire body, held every two years.

The report of the proceedings of the most recent C.C.I.F. plenary meeting contains recommendations of principles concerning telephone transmission, standard reference systems, and general rules for the layout and design of transmission systems (terminal, intermediate, and line equipment), simultaneous operation of telephony and telegraphy in cable, and co-ordination of radio telephony and land wire systems.

There is included in the publication a series of master specifications for cable, loading coils, repeaters, and auxiliary apparatus. Rules are also given for protective measures to be taken against high tension interference and electrolytic or chemical corrosion. One section is devoted



to maintenance questions which are dealt with in considerable detail by descriptions and specifications of suitable measuring apparatus and appropriate testing methods and routines. Operating, traffic, and tariff problems are governed by specific recommendations contained in the fifth and last section. An exhaustive bibliography of English, French, and German publications, of which over 1000 references are listed, is also included.

This work gives a comprehensive account of modern telephone communication practice. It contains the accumulated experience and knowledge of leading telephone experts of the world who have contributed to the work of the C.C.I.F., and should prove a valuable reference for telephone engineers. The section of the book which is of metallurgical interest is that on "Protection of Telephone Cables Against Corrosion Due to Electrolysis" (pp. 133-156), which gives recommendations as to measures to be taken for protection.

**V.D.I. Jahrbuch, 1937. Die Chronik der Technik.** Herausgegeben im Auftrage des Vereines deutscher Ingenieure von A. Leitner. 15 × 21 cm. Pp. xii + 228. 1937. Berlin: V.D.I.-Verlag G.m.b.H. (R.M. 3.50; V.D.I.-Mitgl., R.M. 3.15.)

This is the fourth of these annual volumes issued by the V.D.I., and covers all the branches of science and technology. The style of the publication is the same, and consists of two parallel columns giving references to the literature for 1936, and short summaries of the subject matter, respectively. The reviews for metallic materials are very brief indeed.

**Book of A.S.T.M. Tentative Standards.** Issued Annually. Med. 8vo. Pp. xxix + 1390, illustrated. 1936. Philadelphia, Pa.: American Society for Testing Materials, 260 S. Broad St. (Paper, \$7.00; cloth, \$8.00.)

The 1936 edition of the Book of A.S.T.M. Tentative Standards contains 264 tentative specifications, methods of test, and definitions of terms covering widely used engineering materials. A large number of the standards are included in this publication for the first time, having been approved during 1936, and a number were revised during the year and are given in their latest approved form. There are 47 items dealing with ferrous metals (forgings, castings, pipe, &c.), and 33 referring to non-ferrous metals (aluminium, magnesium, copper and copper alloys, zinc, die-castings, &c.). All those that are new or recently revised have been referred to individually in *Met. Abs.*

New tentative specifications of metallurgical interest which are published for the first time cover: uniformity tests, by the Preece method, of coating on zinc-coated iron or steel wire; hard-drawn copper alloy wires for electrical conductors; sheet and strip phosphor-bronze; seamless copper-nickel alloy condenser tubes and ferrule stock; magnesium-base alloy bars, rods, and shapes; test for defectivity of thermoflex (thermostatic metals); alloy-steel bolting materials and carbon and alloy-steel nuts for service up to 1100° F.; high-strength structural rivet steel; fabricated steel bar or rod mats and welded wire fabric for concrete reinforcement; high-carbon and quenched-carbon steel joint bars; one-wear and two-wear wrought steel wheels; seamless alloy-steel (4-6 per cent. chromium) heat-exchanger and condenser tubes, and still tubes for refinery service; single and double refined wrought-iron bars and light-weight and thin-sectioned grey-iron castings.

To facilitate the use of the book a complete subject index is included, listing items under the materials and subjects to which they apply; and two tables of contents are given, one listing the standards in the order they appear (grouped under general subjects) and a second listing the items in numerical sequence of serial designations.

**Who's Who in Engineering. A Biographical Dictionary of the Engineering Profession, 1937.** Editor: Winfield Scott Downs. Fourth Edition. Med. 8vo. Pp. liii + 1638. 1937. New York: Lewis Historical Publishing Co., Inc. (\$10.00.)

For the second time, this well-known biography of American engineers has been produced with the collaboration of the American Engineering Council. Those who are qualified to have their names included in the volume are: (a) engineers of outstanding and acknowledged professional eminence; (b) engineers of at least 10 years' active practice, at least 5 years of which have been in responsible charge of important engineering work; and (c) teachers of engineering subjects in colleges or schools of accepted standing who have taught such subjects for at least 10 years, at least 5 years of which have been in responsible charge of a major engineering course in such college or school. The term "engineer" has been interpreted broadly, and numerous metallurgists, chemists, &c., are included.

The volume is well and clearly printed, and well bound. The information given is very full. This fourth edition is most welcome, and should be secured by all reference libraries in any way concerned with engineering and allied subjects.

**Kelly's Directory of Merchants, Manufacturers, and Shipbuilders of the World.**  
Fifty-First Edition. Volume I. Pp. cccxi + 1918. Volume II. Pp. ccii + 2164. 1937. London: Kelly's Directories, Ltd. (6s.)

The 1937 edition of *Kelly's Directory of the Merchants, Manufacturers, and Shippers of the World*, consists of two volumes, both well produced and conveniently arranged. A comprehensive directory of all the wholesale and manufacturing trades of the British Isles forms the major part of Volume II, and occupies no less than 1700 pages. For those who require a general trade directory of the British Isles there is nothing better. The information is classified both alphabetically and by trades, and it is information which has been obtained as a result of many years' activities in the publication of this Directory, and an exhaustive annual revision carried out by experts in directory work. The rest of Volume II is devoted to the British Empire other than the British Isles, and here the names of agents, exporters, importers, wholesale merchants, and manufacturers are arranged alphabetically by trades and towns under the various geographical divisions. To take one instance—the names for New Zealand form a separate division, and in this division are separate sections for the various towns in New Zealand; in the section for each town the names of the bankers, wholesale merchants, brokers, shipping agents, importers and exporters, and manufacturers are arranged by order of trades.

In the companion Volume I will be found particulars for all the countries of the world other than the British Empire. The information is arranged similarly to that in the Dominion and Colonial Section of Volume II. Here the British exporter will find what he needs to know with regard to world markets and the firms overseas with whom he wishes to get in touch. There are ample metallurgical and engineering references.