

# METALLURGICAL ABSTRACTS

(GENERAL AND NON-FERROUS)

Volume 1

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Part 4

## I.—PROPERTIES OF METALS

(Continued from pp. 113-119.)

\***Elasticity Constants of Aluminium Single Crystals.** E. Goens (*Ann. Physik*, 1933, [v], 17, 233-242; and *Wiss. Abhandl. Physikal.-Tech. Reichsanst.*, 1933, 17, 167-176).—Details of work the results of which have already been published (*J. Inst. Metals*, 1930, 43, 392).—v. G.

†**The Thermal Properties of Aluminium and Their Applications.** A. de Biran (*Rev. Aluminium*, 1933, 10, 2263-2278).—The thermal properties of aluminium, in most cases compared with those of its principal alloys and of other metals, are brought together and discussed. The properties specifically studied are: linear expansion, both free and partly and completely inhibited, and with differential heating; specific heat from 0° to 658° C.; thermal conductivity and Lorentz coeff. from -193° to +200° C.; diffusibility; convection; radiation; thermal properties of liquid and gaseous aluminium, and effect of the temperature on the mechanical properties of the metal.—J. H. W.

\***Contribution to the Thermochemistry of Aluminium.** A. Meichsner and W. A. Roth (*Z. Elektrochem.*, 1934, 40, 19-26).—The heat of formation of  $\alpha$ -aluminium oxide by the ignition of very pure aluminium in sintered corundum boats was found to be  $+393.3 \pm 0.4$  kg.-cal. at 20° C. and constant pressure. The earlier lower results are explained as being due to ignition in clay boats in which the endothermic reaction lowers the heat of oxidation. The heat of formation of crystalline aluminium carbide formed by igniting 92.4% pure carbide in corundum boats was found to be  $+20 \pm 3$  kg.-cal. at 20° C. This is ten times lower than the previous direct determination, owing to incomplete combustion in the earlier experiments.—J. H. W.

**The Alleged Allotropy of Aluminium.** Anon. (*Metallurgist* (Suppt. to *Engineer*), 1933, 9, 95-96).—A discussion of two papers, respectively by A. Schulze and O. Tiedemann, in *Metallwirtschaft*, 1933, 12, 667, 669. See *Met. Abs.*, this volume, p. 65.—R. G.

\***Investigations on Beryllium and the Copper-Beryllium System.** Heinz Borchers (*Dissertation: Tech. Hochschule, Aachen*, 1930, 13 pp.).—See *J. Inst. Metals*, 1932, 50, 145, 602.—A. R. P.

\***Investigations of the Hot Strength of Copper by Static and Alternating Deformation.** W. Schwinning and E. Strobel (*Z. Metallkunde*, 1934, 26, 1-5).—Complete tension-elongation diagrams have been constructed and the endurance strength (rotating bending) has been determined for hard-drawn and soft wires (5 mm. diam.) at 20°, 100°, 200°, 250°, and 300° C. The results are shown in diagrams and tables and compared with those obtained with aluminium and Lantal (cf. *J. Inst. Metals*, 1932, 50, 600). Alternating deformation seems to accelerate the recrystallization process.—M. H.

**Comparative Properties of Oxygen-Free High-Conductivity Phosphorized and Tough-Pitch Coppers.** W. R. Webster, J. L. Christie, and R. S. Pratt (*Trans. Amer. Inst. Min. Met. Eng.*, 1933, 104, Inst. Metals Div., 166-169; discussion, 169).—For abstract of the paper see *J. Inst. Metals*, 1933, 53, 177. In the discussion W. B. Price stated that in drawing tubes of  $\frac{3}{8}$  in. outside diameter from a wall thickness of 0.018 in. down to one of 0.005 in. he

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

† Denotes a first-class critical review.

had found no difference in the number of anneals required when oxygen-free high-conductivity copper was used instead of phosphorized copper, 7 being required in each case.—A. R. P.

**Copper Embrittlement.**—II. L. L. Wyman (*Trans. Amer. Inst. Min. Met. Eng.*, 1933, 104, Inst. Metals Div., 141–151).—See *Met. Abs.*, this volume, p. 113, and abstract below.—A. R. P.

**Properties of Copper Deoxidized with Calcium.** Lyall Ziekrick (*Trans. Amer. Inst. Min. Met. Eng.*, 1933, 104, Inst. Metals Div., 152–162).—See *Met. Abs.*, this volume, p. 114, and abstract below.—A. R. P.

[Joint Discussion on “Copper Embrittlement” and on “Properties of Copper Deoxidized with Calcium.”] E. E. Schumacher. D. L. Ogden. D. K. Crampton. W. H. Bassett. E. R. Darby. T. A. Wright (*Trans. Amer. Inst. Min. Met. Eng.*, 1933, 104, Inst. Metals Div., 162–165).—For abstracts of the papers see *Met. Abs.*, this volume, pp. 113 and 114. E. E. S. stated that he had found that 0.18% residual calcium in copper lowered the conductivity only to 97.5%, and suggests that Z.’s low value of 86.1% was due to the presence of impurities, e.g. silicon and aluminium picked up from the graphite crucible; with an alundum-lined crucible no contamination occurs. Although lithium is a better deoxidizer, S. has found that it more readily reduces refractory linings, and he therefore prefers calcium or, better still, a mixture of lithium with calcium boride. D. L. O. confirmed S.’s results on absorption of impurities from refractories, but found iron to be the chief element absorbed. Using calcium or calcium boride deoxidizers, he has obtained conductivities of 100.5–101% on annealed No. 12 copper wire; 0.03% iron reduces the conductivity to 95% after complete deoxidation, but only to 100.6% if 0.005% oxygen is present. D. K. C. reported that he had obtained consistent conductivity values of 101% on copper deoxidized with a 50:50 cadmium–lithium alloy when melting 1000 lb. charges in an Ajax-Wyatt furnace. E. R. D. stated that with certain high-strength bronzes tensile strengths of 100,000 lb./in.<sup>2</sup> were obtained when 0.01% calcium remained in the alloy; with 0.03% calcium the strength was reduced by 20%.—A. R. P.

**\*On the Specific Heats of Tungsten, Molybdenum, and Copper.** H. L. Bronson, H. M. Chisholm, and S. M. Dockerty (*Canad. J. Research*, 1933, 8, 282–303).—The results are given of a long series of determinations from –20° to 500° C. A new type of all-copper adiabatic calorimeter has been designed and used. The complete elimination of water from the calorimeter removed several sources of error and resulted in increased reliability and accuracy. Two entirely different methods were used in determining the specific heats. The usual “method of mixtures” was used to determine the mean specific heat for a large temperature change, and was applied to all 3 metals over the entire range of temperature. The specific heat of copper was also determined for 5° or 10° intervals from –5° to 110° C. by heating the calorimeter electrically. It has been quite definitely shown that the specific heats of these metals over a temperature range as large as 0° to 500° C. cannot be expressed as a linear function of the temperature. An equation of the form  $C_p = A + BT - C/T^2$  was arrived at from theoretical considerations and the constants were determined empirically with the following results: tungsten . . .  $C_p = 0.03199 + 0.00000328T - 129/T^2$ ; molybdenum . . .  $C_p = 0.06069 + 0.0000120T - 361/T^2$ ; copper . . .  $C_p = 0.09292 + 0.0000136T - 452/T^2$ , where the unit of heat is the 20° calorie and  $T$  is abs. temperature. The average deviation of the individual determinations from the values calculated by these equations was only about 0.1%. As a matter of convenience and for purposes of comparison, linear equations applicable over smaller ranges of temperature are also given.—S. G.

**\*On the Specific Heat of Copper from –78° to 0° C.** S. M. Dockerty (*Canad. J. Research*, 1933, 9, 84–93).—A continuation of previous work (see preceding

abstract). The "method of electrical heating" and adiabatic calorimetry have been extended to determine the specific heat of copper from  $-78^{\circ}$  to  $0^{\circ}$  C. The equation previously given for the specific heat of copper contained only the first 2 terms of the Debye expansion, and was found to hold below  $-30^{\circ}$  C. The following equation containing 4 terms of the Debye expansion fits the experimental curve from  $-78^{\circ}$  to  $500^{\circ}$  C. with a maximum deviation of only about 0.05%:

$$C_p = 0.3889 + 5.65 \times 10^{-5} T - \frac{2000}{T^2} \left( 1 - \frac{321^2}{28T^2} + \frac{321^4}{910T^4} \right),$$

where the units are joules/grm. $^{\circ}$  K. The constants of this equation were determined empirically, and their close relation to theoretically expected values is discussed.—S. G.

**\*On the Solidification Temperature of Iridium.** F. Henning and H. T. Wensel (*Ann. Physik*, 1933, [v], 17, 620–634; and *Wiss. Abhandl. Physik.-Tech. Reichsanst.*, 1933, 17, 192–206).—A redetermination gave  $2454^{\circ}$  C. as the melting point.—v. G.

**\*Occurrence of Irregularities in Lead Cable Sheathing and Their Relation to Failures.** W. H. Bassett, Jr., and C. J. Snyder (*Trans. Amer. Inst. Min. Met. Eng.*, 1933, 104, Inst. Metals Div., 254–271; discussion, 271–272).—Structural irregularities in lead cable sheaths may be produced by imperfect welds, by yellow oxide inclusions, by entrapped gases, by inclusions of dirt, and by the presence of large areas filled with suboxide. Photographs showing characteristic defects produced by these irregularities are given, and the precautions necessary to produce sound sheathing are discussed on the basis of the results obtained in a series of large-scale tests. These show that splits due to defective welds can be avoided by maintaining the proper extrusion temperature and by avoiding excess lubrication; the lead should be transferred to the press at  $400^{\circ}$  C. and the die-block kept at  $200^{\circ}$ – $210^{\circ}$  C., no lubrication should be used on the cylinder walls, and only a minimum amount applied to the face of the ram. Scrap lead should be melted separately and thoroughly skimmed before use, and a special pouring equipment should be used for filling the press container. Even then it is probably impossible to eliminate all suboxide from the sheath extruded during the first quarter of each extrusion cycle, but that which remains can be reduced to an insignificant amount. In the discussion in reply to E. E. Schumacher, W. H. B. stated that lead flows more rapidly in the centre of the lead container, but is divided and somewhat retarded by the bridge; the new charge, carrying with it the suboxide, forces its way down through the middle of the cavities in each side of the die-block.—A. R. P.

**†Some Characteristics of Nickel and Its Alloys.** W. R. Barclay (*Proc. Chem. Eng. Group, Soc. Chem. Ind.*, 1932, 14, 75–82).—A brief review of the most important properties and uses of nickel and its principal alloys, especially those having characteristic non-scaling properties and high creep limit, and those having peculiar magnetic properties.—A. R. P.

**The Preparation of Pure Iron and Nickel.** F. Winter (*Metallbörse*, 1933, 23, 957–958).—The carbonyl method and its various modifications are described briefly.—A. R. P.

**Resistance of Nickel in Transverse Magnetic Fields at Various Temperatures.** A. Drigo (*Nuovo cimento*, 1932, 9, 201–223).—See *J. Inst. Metals*, 1933, 53, 1267.—S. G.

**\*Diffusion of Hydrogen Through Palladium.** V. Lombard and C. Eichner (*Compt. rend.*, 1932, 194, 1929–1931; *Sci. Abs.*, 1932, [A], 35, 890).—The present experiments relate to the diffusion of commercial electrolytic hydrogen through a palladium plate 0.314 mm. thick into a vacuum. The gas was under constant pressure (370 mm. mercury) at temperatures between  $196^{\circ}$  and  $600^{\circ}$  C., and also at constant temperature ( $372^{\circ}$  C.) under pressures varying



from atmospheric to 40 mm. mercury. Comparative experiments were also made with dried and purified hydrogen. The data are represented in the paper by curves showing the influence of temperature and pressure. Uniformity of diffusion is only slowly established around 278° C., but rapidly above 400° C. Circumstances which alter the diffusion power of palladium are discussed. The formula  $d = Kp^{0.8}$  ( $K = \text{const.}$ ) appears to represent the influence of pressure.—S. G.

**\*New Researches on the Diffusion of Hydrogen Through Palladium.** Victor Lombard and Charles Eichner (*Bull. Soc. chim. France*, 1933, [iv], 53, 1176-1206).—With a vacuum on one side the rate of diffusion ( $D$ ) of hydrogen through palladium sheet 1 mm. thick at 490°-617° C. is given by the expression:  $D = KP^{0.5}$ , where  $P$  is the hydrogen pressure. If hydrogen is present on both sides of the metal at pressures of  $P$  and  $p$ , then  $D = K(P^{0.5} - p^{0.5})$ . Between 350° and 850° C. the effect of temperature is given by the expression  $D = 20.73T^{0.5} \cdot e^{-2022/T}$ . The permeability to hydrogen is strongly influenced by the purity of the metal.—A. R. P.

**\*Optimum Conditions for the Diffusion of Hydrogen Through Platinum.** V. Lombard and C. Eichner (*Compt. rend.*, 1932, 195, 322-324; *Sci. Abs.*, 1932, [A], 35, 1004).—Using the apparatus of a previous investigation (preceding abstract), the experimental data are now recorded for the diffusion of pure dry hydrogen through platinum plates of thickness 0.199, 0.105, and 0.051 mm., respectively, at temperatures varying from 275° to 606° C. and at pressures from 70 to 772 atm.—S. G.

**Native Silver Wire: Notes on Its Formation and Possible Significance.** C. B. E. Douglas (*Bull. Inst. Min. Met.*, 1933, (341), 5 pp.; discussion, *ibid.*, (342), 21-24; (348), 3; and (summary) *Met. Ind. (Lond.)*, 1933, 42, 273-275).—Evidence is adduced which indicates that native silver wire has been formed by low-temperature (120°-150° C.) dissociation of argentite (silver sulphide).—A. R. P.

**\*Researches on Some Problems Associated with the Oligodynamical Bactericidal Action of Silver.** Luigi Schioppa (*Ann. Igiene*, 1933, 43, 571-584; *Chem. Zentr.*, 1933, 104, II, 3603-3604).—The bactericidal action of metallic silver is not affected by the hardness of the water or by the presence of iron and manganese, but is slightly reduced by the presence of hydrogen sulphide.—A. R. P.

**\*Slipping and Hardening in Single-Crystals of Zinc.** M. Straumanis (*Z. Krist.*, 1932, 83, 29-34; *Sci. Abs.*, 1932, [A], 35, 1182).—A case of pure translation in zinc crystals is described, the [1010] agreeing with that found by Mark, Polanyi, and Schmid. The application of stress caused a slipping of crystal laminae about 0.8 $\mu$  thick. Inside these laminae there was a much slighter secondary slipping. Slipping occurs up to a maximum distance of 1600 lattice planes in the [1010] direction when the (1120) face of the underformed crystal approximates to the inclination of the (1122) face.—S. G.

**Solubility of Gases in Metals.** V. H. Gottschalk and R. S. Dean (*Trans. Amer. Inst. Min. Met. Eng.*, 1933, 104, Inst. Metals Div., 133; discussion, 133-135).—For abstract of the paper, of which only an abstract is printed here, see *J. Inst. Metals*, 1932, 50, 470. In the discussion E. R. Darby stated that the gases causing greatest difficulty in lead, tin, and copper alloys are those resulting from reduction of oxides by reducing materials in sand cores, F. R. Hensel outlined a programme of experiments on the effect of ultrasonic waves on gas absorption by and removal from metals, P. D. Merica brought forward some theoretical considerations on the mechanics of gas absorption, and H. D. Hibbard discussed the subject as it affects steel.—A. R. P.

**Influence of Gases on Metals and Influence of Melting in Vacuo.** Wilhelm J. P. Rohn (*Trans. Amer. Inst. Min. Met. Eng.*, 1933, 104, Inst. Metals Div., 137; discussion, 137-138).—For abstract of the paper, of which only an abstract is printed here, see *J. Inst. Metals*, 1932, 50, 215. In the discussion

J. H. Scaff and R. C. Dalzell stated independently that in their practical experience vacuum melting of copper (at  $10^{-5}$ – $10^{-6}$  mm. of mercury) did not eliminate oxygen present as cuprous oxide, and that even after 2 hrs.' melting wire drawn from this copper was subject to hydrogen embrittlement. In reply, R. suggests that the discrepancy between his results and those of S. and D. may be due to the effect of impurities.—A. R. P.

†**The Surface Tension of Molten Metals.** A. I. Krynitsky (*Metallurgist* (Suppt. to *Engineer*), 1933, 9, 76–77).—A summary of a paper by K. in *Metals and Alloys*, 1933, 4, 79. See *J. Inst. Metals*, 1933, 53, 486.—R. G.

\***On Liquid Metal Single Crystals.**—I. E. Donat and O. Stierstadt (*Ann. Physik*, 1933, [v], 17, 897–914).—Single bismuth crystals with the rod axis parallel or perpendicular to the (111) axis have been prepared by a modification of Goetz's method (see *J. Inst. Metals*, 1930, 43, 397). The anisotropy of the electrical resistance is given by the relation  $\rho_{11} : \rho_{\perp} = 1.27$  ( $20^{\circ}$  C.), 1.37 ( $230^{\circ}$  C.), and 1.29 ( $271^{\circ}$  C.). Above the melting point the conductivity is independent of the orientation of the solid metal, although metal which has been heated to not more than  $10^{\circ}$  C. above the melting point solidifies again with its previous orientation unless the liquid is shaken.—v. G.

†**Raising the Endurance Limit by Surface Pressure.** O. Föppl. A. Thum (*Z.V.d.I.*, 1933, 77, 1335–1337).—A discussion. F. attributes the effect of pressure in raising the endurance limit of metals to deformation of the surface and consequent hardening, whereas T. attributes it to the compression stresses produced in the surface layers.—v. G.

\***On the Dependence of the Modulus of Elasticity and the Damping of Ferromagnetic Metals on the Intensity of Magnetization.** O. von Auwers (*Ann. Physik*, 1933, [v], 17, 83–106).—The materials examined were nickel rod (hard and annealed), nickel tube (soft), Permalloy, soft iron, and hard steel. The change in modulus of elasticity is greater the softer the material and the greater the magnetostriction. Longitudinal tension practically obscures the effect.—v. G.

\***Contributions to the Data on Theoretical Metallurgy. I.—The Entropies of Inorganic Substances.** K. K. Kelley (*U.S. Bur. Mines, Bull. No. 350*, 1932, 62 pp.).—Methods of calculating entropies from experimental data are described, and the values of the entropies at  $298.1^{\circ}$  K. for elements and compounds met with in metallurgy are calculated and the results tabulated.

—A. R. P.

\***Action at a Distance of Metals on Bacteria and Yeast.** G. A. Nadson and C. A. Stern (*Compt. rend.*, 1932, 194, 1597–1600; *Brewing Trade Rev.*, 1932, 46, 274; *C. Abs.*, 1932, 26, 4076).—Metal plates, 1 mm. thick, were fastened to the lids of petri dishes at a distance of 1–2 mm. from the culture. Colonies of *prodigiosum*, *bacterium ponticum* Egor, and *S. cerevisiae* were then allowed to develop in the dark. Metals retard the development of the micro-organisms in the order lead > copper > aluminium.—S. G.

**On the Mechanism of Superconductivity.** Carl Benedicks (*Ann. Physik*, 1933, [v], 17, 169–184).—Theoretical considerations.—v. G.

\***The Effect of High-Frequency Currents on the Transition Point of Superconductors.** E. F. Burton, J. O. Wilhelm, A. Pitt, and A. C. Young (*Canad. J. Research*, 1933, 9, 630–636).—A continuation of work on superconducting phenomena for high-frequency currents and the interaction of high-frequency and direct currents. It is found for thin films of tin that there is no appreciable change in the transition point for frequencies from zero up to  $3 \times 10^7$  cycles per second. There is no effect on the high-frequency point due to d.c. or on the d.c. point due to high-frequency currents, when the value of these currents is below about 20 milliamp. There is a very appreciable effect on the d.c. point when high-frequency currents up to 200 milliamp. are superimposed on the d.c. This effect varies with the strength of the high-frequency current and

not, as previously thought, with the ratio of the high-frequency to the direct current.—S. G.

**Conductivity of Metals and Supraconductivity.** W. J. de Haas and J. Voogd (*Congrès internat. élect. Paris, Sect. I, Rapport No. 10*, 1932, 41 pp.; *Sci. Abs.*, 1932, [A], 35, 1268).—A general account of the work carried out at Leiden, Toronto, and Berlin, in connection with supraconductivity. Among the questions discussed are: (1) whether the "ideal" resistance (apart from the effect of impurities, lattice distortion, &c.) becomes definitely zero at sufficiently low temperature; (2) the form of the temperature-resistance relation; (3) whether the transition in the ideal case is continuous or discontinuous; (4) the changes in other physical properties at the transition point, and (5) whether all metals would be superconducting at sufficiently low temperatures. Work and general results on alloys are next described, and finally the effect of a magnetic field is described and discussed in some detail.

—S. G.

**Low Temperature H.F. Conductivity of Metals.** J. C. McLennan (*Congrès internat. élect. Paris, Sect. I, Rapport No. 11*, 1932, 10 pp.; *Sci. Abs.*, 1932, [A], 35, 1268).—The absorption coeff. of lead for  $\beta$ -rays from mesothorium is unaltered on passing through the supraconducting transition point, and the same is true of its photoelectric emission and its absorption coeff. for visible light. The resistance of lead, tin, and tantalum has been measured at frequencies up to 16 million  $\sim$ , and it is found that the transition point falls with increasing temperature; by extrapolation, the phenomena of supraconductivity would not exist at frequencies of about  $10^9 \sim$ . It is concluded that some process with a relaxation of time of the order of  $10^{-7}$  or  $10^{-8}$  seconds is concerned in the phenomena.—S. G.

†**Electrical Conductivity and Thermoelectricity.** A. Sommerfeld (*Congrès internat. élect. Paris, Sect. I, Rapport No. 9*, 1932, 39 pp.; *Sci. Abs.*, 1932, [A], 35, 1270).—A historical survey is given of the old electronic theory, and S. then deals with the new theory founded on Pauli's exclusion principle, which is developed supposing the temperatures are very low, so that the electronic gas is completely degenerate. The theory is then completed thermodynamically, Fermi's distribution function being introduced. Electrical and thermal conductivities are next dealt with, followed by thermoelectricity. All these questions are dealt with from the point of view of the corpuscular representation of the free electrons. Finally, the effect of the lattice formed by the ions of the metal is considered, together with the electronic waves of wave mechanics.—S. G.

\***On the Dispersion Theory in Metallic Conductors.** Yoshio Fujioka (*Sci. Papers Inst. Phys. Chem. Res. Tokyo*, No. 459, 1933, 202-215).—Theoretical. An extension of the work of Fujioka (*Z. Physik*, 1932, 76, 537) and Fröhlich (*Z. Physik*, 1933, 81, 297) on the conductivity and dielectric constant of a metal under the influence of light waves. A tentative comparison with numerical data for silver is given.—W. H.-R.

\***Discrepancy Between Theory and Experiment in Cold Emission.** Willard H. Bennett (*Phys. Rev.*, 1933, [ii], 44, 859-860).—Electron currents drawn from cold metals by intense fields are generally much larger than those to be expected from the theory of Fowler and Nordheim, and this is usually regarded as due to the existence of sharp points on the surface. Experiments show that if the emitted electrons can strike glass, they may cause the emission of positive ions, which are then deposited on the cold metal cathode and reduce its work function and thus produce much larger currents than those calculated for a clean surface. By preventing the electrons from striking glass, characteristics near to the theoretical values have been obtained.

—W. H.-R.

\***The Effect of Temperature on the Energy Distribution of Photo-Electrons.** I.—Normal Energies. Lee A. Du Bridge and R. C. Hergenrother (*Phys. Rev.*,



1933, [ii], 44, 861–865).—The distribution of normal energies (*i.e.* the energies associated with the velocity components normal to the emitting surface) of photo-electrons emitted from a strip of molybdenum foil at temperatures from 300° to 965° K. have been investigated. Current-voltage curves were analysed by the method of Fowler (*J. Inst. Metals*, 1932, 50, 219), and the results agree with the theory of Du Bridge (*J. Inst. Metals*, 1933, 53, 343) (*cf.* following abstract).—W. H. R.

\*The Effect of Temperature on the Energy Distribution of Photo-Electrons.

II.—Total Energies. Walter W. Roehr (*Phys. Rev.*, 1933, [ii], 44, 866–871).—*Cf.* preceding abstract. The total photo-electric emission from a molybdenum filament at the centre of a large collecting sphere has been investigated at temperatures from 300° to 1000° K. Current-voltage curves analysed by Fowler's method, agreed with the theory of Du Bridge (*J. Inst. Metals*, 1933, 53, 343), confirming the evidence that the electrons in a metal obey the Fermi statistics, and that, in escaping as photo-electrons, the distribution is not appreciably affected by collision phenomena. The distribution curves show a most probable energy much nearer to the maximum energy than that found by previous investigators; this may be due to better outgassing conditions in the present work. The effect of temperature on the tail of the current-voltage curves is quite pronounced, indicating that a sharply defined maximum retarding potential exists only at 0° K.—W. H. R.

## II.—PROPERTIES OF ALLOYS

(Continued from pp. 119–126.)

\*Thermal Expansivity of Aluminium Alloys. L. W. Kempf (*Trans. Amer. Inst. Min. Met. Eng.*, 1933, 104, Inst. Metals Div., 308–322; discussion, 322–324; also (abbreviated) *Automotive Ind.*, 1933, 68, 398).—The coeff. of thermal expansion of binary aluminium alloys with up to 33% copper, 8% iron, 40% silicon, and 20% nickel, of 10% copper-aluminium alloys with up to 5% iron, of 5 and 10% copper-aluminium alloys with up to 10% nickel, of 3% nickel-aluminium alloys with up to 8% iron, and of 5 and 10% nickel-aluminium alloys with up to 10% copper are shown in tables and graphs. The general effect of adding metals of lower thermal expansivity to aluminium is to produce an alloy with a lower coeff. of expansion than pure aluminium, the coeff. decreasing with increasing proportion of the added element. Iron has the greatest effect, then nickel and silicon, whilst copper is much less effective than any of the other three metals. The causes of the variations between K.'s results and those of earlier workers for the copper-aluminium system are discussed; they are attributed to structural changes due to heat-treatment. The total volume changes in aluminium alloys incidental to temperature changes may be due to at least two different factors: (a) permanent growth due to temperature variations of the mutual solid solubilities of the constituents and (b) true thermal expansion. The maximum effect due to (a) so far observed corresponds with a unit linear change of 0.0016. In view of this, the materials used in the investigation were stabilized by annealing at 225° C. for about 20 hrs. to effect equilibrium as regards growth. Within the range 20°–300° C. the growth effects were found to be irreversible in the systems examined. The discussion, in which H. H. Lester, D. F. McFarland, H. Scott, and the author took part, deals principally with problems of growth in non-ferrous alloys and the effect of heat-treatment thereon.—A. R. P.

\*Thermic Measurements on Heat-Treatable Aluminium Alloys. W. Fraenkel (*Light Metals Research*, 1933, 2, (38), 2–10).—Translated in full, and illustrated by sketches, from *Metallwirtschaft*, 1933, 12, 583. See *Met. Abs.*, this volume, p. 69.—J. C. C.

**\*On the Influence of Additions of Magnesium, Silicon, Vanadium, Chromium, Manganese, Iron, Cobalt, Nickel, Copper, Zinc, Arsenic, Silver, Cadmium, Tin, Antimony, Lead, and Bismuth on the Electrical Conductivity of Aluminium.** H. Bohner (*Z. Metallkunde*, 1934, 26, 45-47).—The specific electrical conductivity of wires of commercial aluminium (99.6-99.7%) with additions of up to 3% of the above metals after annealing at 300° C. and quenching at 500°-550° C. are shown diagrammatically. The electrical conductivity of aluminium is lowered to the greatest extent by about 0.1% of manganese, vanadium, and chromium. The influence of iron, cobalt, nickel, zinc, arsenic, cadmium, tin, antimony, lead, and bismuth, which are either insoluble or very little soluble in solid aluminium, is small.—M. H.

**\*Investigations on the System Aluminium-Barium.** E. Alberti (*Z. Metallkunde*, 1934, 26, 6-9).—The alloys were prepared by adding baryta to molten aluminium at 1000°-1100° C. under a eutectic flux of barium chloride and fluoride. The equilibria in the system up to 37% barium have been determined by differential thermal analysis in an argon atmosphere; within this range the system is a simple eutectiferous one with no solid solutions. The eutectic between aluminium and a barium-rich compound occurs at 651° C. and 2.1% barium, and the liquidus reaches 1013° C. at 36.3% barium. Characteristic microstructures are illustrated.—M. H.

**\*Equilibrium Relations in Aluminium-Chromium Alloys of High Purity.** William L. Fink and H. R. Freche (*Trans. Amer. Inst. Min. Met. Eng.*, 1933, 104, Inst. Metals Div., 325-334).—The system has been examined by thermal analysis and micrographic examination of alloys with up to 2% chromium. Dissolution of the alloy with 1.4% chromium in dilute hydrochloric acid left a residue of rhombohedral plates of  $\text{CrAl}_7$ . The solid solubility of this compound in aluminium corresponds with 0.77% chromium at the peritectic temperature (661° C.), but at 500° C. only 0.2% chromium is retained in solid solution. With up to 0.4% chromium, the alloys melt at a constant temperature of 660°-661° C.; with 2% chromium the liquidus is raised to 780°.—A. R. P.

**\*Influence of Heavy Metals on Aluminium Alloys. II.—The Influence of Chromium.** P. Röntgen and W. Koch (*Z. Metallkunde*, 1934, 26, 9-13).—See *J. Inst. Metals*, 1933, 53, 694. The influence of 0.1-4% chromium on the structure, tensile strength, elongation, Brinell hardness, and age-hardening of forged Lantal and of aluminium alloys containing (a) copper 1-10%, (b) nickel 1-10%, (c) manganese 1-8%, and (d) copper 1-6 and nickel 0.5-5% has been investigated. With less chromium than corresponds to the eutectic composition the tensile strength and hardness is not appreciably influenced; with more than this these properties are improved but the elongation is reduced. The chromium : copper ratio in age-hardenable ternary and quaternary alloys should be 1 : 5-10; 0.4-0.8% chromium increases the tensile strength of age-hardened Lantal by 11% and the hardness by 30%.—M. H.

**\*Strength Tests of Thin-Walled Duralumin Cylinders in Pure Bending.** Eugene E. Lundquist (*Tech. Notes, Nat. Advis. Cttee. Aeronautics*, No. 479, 1933, 1-10).—The result of pure bending tests on 58 thin-walled cylinders of circular cross-section with ends clamped to rigid bulkheads show that the stress on the extreme fibre at failure (calculated by the ordinary theory of bending) is 30-80% greater than the compressive stress at failure for thin-walled cylinders in compression. The ratio of length to radius has no consistent effect on the bending strength, and the size of the wrinkles which form on the compression half of a cylinder in bending is approximately the same as that of the wrinkles which form in the complete circumference of a similar cylinder in compression. Wrinkling prior to failure does not apparently reduce the stress at failure, and after failure the wave-lengths of the wrinkles



in the axial direction are approximately equal to those of the wrinkles in the circumferential direction.—A. R. P.

†The Alloys of Iron with Aluminium. Anon. (*Metallurgist* (Suppt. to *Engineer*), 1933, 9, 93-94).—A critical discussion of a paper by Ōsawa, *Sci. Rep. Tōhoku Imp. Univ.*, 1933, 22, 803; see *Met. Abs.*, this volume, p. 7; and *J. Inst. Metals*, 1933, 53, 616.—R. G.

\*On the Equilibrium Diagram of the Aluminium-Magnesium System. Masuo Kawakami (*Kinzoku no Kenkyū*, 1933, 10, (12), 532-554).—[In Japanese.] The equilibrium diagram of the system aluminium-magnesium has been determined by thermal, microscopic, and X-ray analyses and by measurements of the single potential and electrical resistance. Three intermetallic phases exist. Aluminium and magnesium are mutually soluble, forming  $\alpha$ - and  $\epsilon$ -phases, respectively. The intermetallic phases  $\beta$ ,  $\gamma$ , and  $\delta$  consist mainly of the compounds  $\text{Al}_3\text{Mg}_5$ ,  $\text{AlMg}$ , and  $\text{Al}_3\text{Mg}_4$ , respectively. The  $\epsilon$ -phase, found in this investigation, is formed by the peritectic reaction melt +  $\delta \rightleftharpoons \gamma$ .—S. G.

\*Equilibrium Relations in Aluminium-Manganese Alloys of High Purity. —II. E. H. Dix, Jr., William L. Fink, and L. A. Willey (*Trans. Amer. Inst. Min. Met. Eng.*, 1933, 104, Inst. Metals Div., 335-352).—Since even small amounts of iron profoundly affect the equilibria in the aluminium-manganese system, the system has been re-examined using aluminium containing only silicon 0.003-0.005, iron 0.006-0.008, and copper 0.003-0.004%; for alloys with more than 92% aluminium the manganese was introduced by reduction of the pure chloride with pure aluminium, and for alloys with a lower aluminium content, commercial manganese with silicon 1.63, iron 1.24, copper 0.12, aluminium 0.85, and manganese 96.16% was used. The eutectic occurs at 1.95% manganese and 658.5° C., and the solid solubility of manganese in aluminium decreases from 1.82% at the eutectic temperature to 0.36% at 500° C. The hypoeutectic liquidus is a straight line intersecting the eutectic horizontal at 1.95% manganese. The first branch of the hypereutectic liquidus starts from the eutectic, and intersects the second branch at 710° C. and 4.06% manganese; it corresponds with the separation of  $\text{MnAl}_6$ . The second branch corresponding with the separation of  $\text{MnAl}_4$  rises to above 800° C. with 10% manganese.  $\text{MnAl}_6$  decomposes at 710° C. into  $\text{MnAl}_4$  and liquid aluminium containing 4.06% manganese in solution.—A. R. P.

\*Influence of Heavy Metals on Aluminium Alloys. III.—The Influence of Molybdenum. P. Röntgen and W. Koch (*Z. Metallkunde*, 1934, 26, 13-18).—Cf. Röntgen and Koch, *Met. Abs.*, this volume, p. 168. The tensile strength, elongation, and Brinell hardness of the age-hardened aluminium alloy with 4% copper are increased by 1% molybdenum from 35.5 kg./mm.<sup>2</sup>, 20%, and 89, to 37.5, 22.5%, and 104, respectively. The influence of 1% nickel, chromium, cobalt, iron, and manganese, alone and in combination with one another, on the structure and mechanical properties of the 95 : 4 : 1 aluminium-copper-molybdenum alloy, both in the quenched and age-hardened condition, has been studied, as well as the structure, mechanical properties, and age-hardening of a number of very complex alloys with molybdenum, nickel, chromium, cobalt, iron, manganese, silicon, and magnesium in amounts of 0.2-2%, and the influence of simultaneous additions of heavy metals on alloys of the Duralumin type.—M. H.

\*On the Behaviour of Carbides and Silicides in Alloys During Treatment with Acids. [Action of Acids on Silicon-Aluminium Alloys.] Alfred Wiegner (*Dissertation: Tech. Hochschule, Zürich*, 1930, 51 pp.).—An alloy of aluminium with silicon 13 and magnesium 4.9% evolves various silicon hydrides when treated with hydrochloric acid. At 0° C. the amount of silicon in the gases is somewhat greater than that corresponding with the amount of  $\text{Mg}_2\text{Si}$  present; the excess silicon is derived from the aluminium-silicon solid solution. —\* Modi-

fication" of the alloy with an alkali metal does not affect the amount of silicon in the gases, hence "free" silicon in the alloy is not converted into hydride by the action of acids. The amount of silicon evolved by acid attack decreases with increase in temperature of the acid and, to a much smaller extent, with decrease in the acid concentration. Sulphuric acid is less effective than hydrochloric in forming volatile silicon hydrides; nitric acid above 20° C. produces no hydrides. Hydrides are much more readily evolved from quenched alloys than from slowly-cooled alloys; in some cases the rate of evolution is such that the gases take fire spontaneously, and with alloys with a high magnesium content explosions are liable to occur.—A. R. P.

**Beryllium Alloys.** F. Winter (*Metallbörse*, 1933, 23, 669-670, 701-702).—The properties and heat-treatment of beryllium-copper alloys are described in detail.—A. R. P.

**\*On Alloys of Beryllium with Heavy Metals.** W. Hessenbruch (*Z. Metallkunde*, 1933, 25, 245-249; discussion, 249-250).—Abridged from *Heraeus Vacuumschmelze* [10th Anniv. Volume], 1933, 199-232. See *J. Inst. Metals*, 1933, 53, 618-619.—M. H.

**Field and Laboratory Data Covering Tests upon Special [Chromium-Nickel-Iron] Alloys for Barrels, Balls, and Seats.** Walter F. Rogers (*Oil Gas J.*, 1933, 32, (23), 54, 58, 59; *C. Abs.*, 1934, 28, 84).—The use of chromium-nickel-iron alloys for balls and seats makes replacements a negligible expense. Field data are given.—S. G.

**The Metal Cobalt and Some of Its Uses.** B. E. Field (*Min. and Met.*, 1933, 14, 303-305; and (summary) *Metallurgist* (Suppt. to *Engineer*), 1933, 9, 54-55).—A review of the production, properties, uses, and alloys of cobalt with especial reference to cobalt-iron alloys and Stellite.—A. R. P.

**Vitalium—A New [Cobalt-Tungsten-Chromium] Alloy.** Edwin F. Cone (*Iron Age*, 1934, 133, (6), 30).—A short note. Vitalium is an alloy of cobalt, tungsten, and chromium, and is claimed to be particularly non-corrosive to the action of food acids, to have unusual strength, elasticity, and wear-resistance, and to take a high polish. It is used for dental appliances.—J. H. W.

**The Casting of Corrix Metal [Copper-Aluminium-Iron Alloy].** Anon. (*Z. ges. Giesserei-Praxis: Das Metall*, 1934, 55, 55-56).—Corrix metal is a new corrosion-resisting alloy, made of pure metals, and containing copper 88.25, aluminium 8.7, and iron 3.05%. Its tensile strength is 61.6 kg./mm.<sup>2</sup>, elongation 20-30%, reduction of area 32%, and Brinell hardness 194, whilst an American alloy of similar composition has a lower tensile strength, an elongation of only 7-10%, no reduction of area, and a Brinell hardness of 137. Corrix metal has a fine-grained structure, its melting point is about 1080° C., sp. gr. 7.6, and shrinkage 1.8%. The melting, moulding, and casting of this alloy are described.—J. H. W.

**The Rate of Precipitation of Nickel Silicide and Cobalt Silicide in the Hardenable Copper-Nickel-Silicon and Copper-Cobalt-Silicon Alloys.** Curtis L. Wilson, Horace F. Silliman, and Eugene C. Little (*Trans. Amer. Inst. Min. Met. Eng.*, 1933, 104, Inst. Metals Div., 131; discussion, 131-132).—For abstract of the paper, of which only an abstract is printed here, see *J. Inst. Metals*, 1933, 53, 183. In the discussion R. F. Mehl summarized the various methods available for studying the rates of reaction and precipitation in alloys, and reviews their accuracy. C. S. Sivil considered that, if dispersion-hardening is the true mechanism of age-hardening, then quenching temperature should not affect the maximum hardness obtainable on ageing unless the age-hardness is the sum of the hardness due to grain-size and that due to precipitation of Ni<sub>2</sub>S.—A. R. P.

**A New Copper-Silicon Alloy. "Herculoy."** M. G. (*Cuivre et Laiton*, 1933, 6, 548).—Abstracted from an article by R. A. Wilkins, *Metals and Alloys*, 1933, 4, 123-126. See *J. Inst. Metals*, 1933, 53, 621.—W. A. C. N.

**Directional Properties in Cold-Rolled and Annealed Commercial Bronze.** Arthur Phillips and Carl H. Samans (*Trans. Amer. Inst. Min. Met. Eng.*, 1933, 104, Inst. Metals Div., 171-180).—See *J. Inst. Metals*, 1932, 50, 661.

—A. R. P.

**The Copper-Rich Alloys of the Copper-Nickel-Tin System.** John T. Eash and Clair Upthegrove (*Trans. Amer. Inst. Min. Met. Eng.*, 1933, 104, Inst. Metals Div., 221-249; discussion, 249-253).—For abstract of the paper see *Met. Abs.*, this volume, p. 121. The discussion, in which O. A. Corson, W. B. Price, D. Stockdale, E. R. Darby, W. M. Corse, A. J. Phillips, D. W. Smith, L. L. Wyman, and the authors took part, centres chiefly round comparison of E. and U.'s results with those of earlier workers in the same field, the terminology applied to the phases, and the age-hardening of nickel-bronzes. With suitable melting and deoxidation methods followed by correct heat-treatment, alloys have been produced consistently having a tensile strength of 96,000 lb./in.<sup>2</sup>, a proportional limit of 55,000 lb./in.<sup>2</sup>, an elongation of 10%, and a reduction in area of 15%.—A. R. P.

**The Uhlman Capillary Metal (Sinterbronze) [for Bearing Bushes].** Joh. Mehrrens (*Z. ges. Giesserei-Praxis: Das Metall*, 1934, 55, 53-54).—If a bronze is made by sintering the constituents in powder form in a high-frequency electric furnace, the resulting alloy has a peculiar porous, "capillary" structure. Owing to its high absorptive power for lubricating oil, it is especially suitable for bushes in bearings, and its use for this purpose is described.

—J. H. W.

**†The Function of Iron in Bronzes and Brasses.** Edmund R. Thews (*Z. ges. Giesserei-Praxis: Das Metall*, 1933, 54, 532-534).—Iron improves the elongation, hardness, and density of most brasses and bronzes, and increases the corrosion-resistance of nearly all copper alloys, but, if not added correctly, may prove detrimental, especially to the machinability. The mechanism of the alloying of the iron and the effect of adding aluminium to the alloys are discussed. In the manufacture of iron-containing tin-bronzes, carbon-free iron is added as a pre-alloy or as a decomposable salt, such as potassium ferrocyanide. As a protective slag, broken glass or calcined soda is used, the latter having the advantage of protecting the melt against the absorption of sulphur. The methods of removing iron when necessary from copper alloys are described.—J. H. W.

**The Precipitation of Alpha from Beta Brass.** Oscar T. Marzke (*Trans. Amer. Inst. Min. Met. Eng.*, 1933, 104, Inst. Metals Div., 64; discussion, 64-68).—For abstract of the paper, of which only an abstract is printed here, see *J. Inst. Metals*, 1933, 53, 184. The discussion, in which D. W. Smith, C. H. Mathewson, M. J. Buerger, A. St. John, and R. F. Mehl took part, is concerned chiefly with the interpretation of O. T. M.'s results and with alternative theories of the mechanism of the precipitation of  $\alpha$ - from  $\beta$ -brass.—A. R. P.

**†Mechanical Properties of Brass.** Fr. Ostermann (*Z. Metallkunde*, 1934, 26, 40-44).—Recent work is reviewed and the results of various workers are summarized in numerous diagrams, which illustrate the effect of cold-work, annealing temperature, and copper content on the hardness, tensile strength, elongation, notch brittleness, and Erichsen value of brass.—M. H.

**The Static and Fatigue Properties of Brass.** Jesse Benjamin Kommers (*Bull. Univ. Wisconsin Eng. Exper. Station Series*, No. 76, 1933, 5-38).—An amplification of a previous paper (see *J. Inst. Metals*, 1931, 47, 376). Additional conclusions are: (1) cold-work in one direction increases the elastic properties for stresses in that sense rather than in the opposite direction; (2) in comparing cold-drawn material annealed at 527° F. (275° C.) with similar material fully annealed, only the 60:40 brass showed an increase in endurance limit greater than the increase in tensile strength; (3) no con-



sistent relation to the endurance limit is shown by proportional elastic limit, Johnson's elastic limit, proof stress or Rockwell hardness.—P. M. C. R.

**Some Effects of Internal Stress on Properties of Drawn Brass Tubes.** D. K. Crampton (*Trans. Amer. Inst. Min. Met. Eng.*, 1933, 104, Inst. Metals Div., 194-213; discussion, 214-215).—For abstract of the paper see *Met. Abs.*, this volume, p. 122. In the discussion C. S. Barrett suggested that the higher stresses in polycrystalline materials are not directly caused by stress concentrations at the grain boundaries, but result from the higher elastic limit, which in turn is due to slip interference at grain boundaries; he also suggested that season-cracking is due to the stress gradient rather than to the magnitude of the stress. W. B. Price considered that a longer period than 2 hrs. is required to relief-anneal drawn brass at 250°C., or, alternatively, the operation should be carried out at 275°C.—A. R. P.

**Nickel-Brass.** Edmund Richard Thews (*Metallbörse*, 1933, 23, 1181-1182, 1213-1214, 1277-1278).—The preparation, properties, composition, and uses of numerous nickel-brasses are described.—A. R. P.

**Special [Copper] Alloys.** Anon. (*Z. ges. Giesserei-Praxis: Das Metall*, 1934, 55, 56).—Gives the mechanical properties and applications of the following: iron bronze; Eisler's alloy (Bath Bronze), and Elephant bronze. See also *J. Inst. Metals*, 1933, 53, 552, 698, and *Met. Abs.*, this volume, p. 125.—J. H. W.

**Certain Physical and Chemical Properties of Gold and Its Alloys.** Mearle W. Wilkinson (*Brit. J. Dental Sci., Prosthetics Section*, 1933, 78, 279-287; correspondence, 331-332, 360-362; 1934, 79, 30-31).—Reprinted from *Pacific Dental Gazette (U.S.A.)*. An elementary account of the metallurgy of gold and its alloys, with special reference to their use in dentistry.—J. C. C.

**\*On Osmiridium.**—I. O. E. Zviagintzev (*Izvestia Platinogo Instituta (Annales de l'Institut de Platine)*, 1932, (9), 31-48).—[In Russian.] See abstract from German source, *J. Inst. Metals*, 1933, 53, 352.—N. A.

**\*Hardness Measurements on Binary Alloys of Lead-Antimony, Antimony-Tin, and Lead-Tin.** Nobutoshi Aoki (*Kinzoku no Kenkyu*, 1934, 11, (1), 1-20).—[In Japanese.] The Brinell hardness of these alloys has been determined and the relation between hardness, microstructures, and equilibrium diagrams investigated. The following were studied: (1) change of hardness with load; (2) change of hardness with loading time; (3) effect of ageing at room temperature; (4) effect of annealing at a temperature nearly below the solidification point; and (5) change of hardness with composition.—S. G.

**\*Contribution to the Knowledge of Bearing Metals on a Tin-Lead Basis.** Arthur Demmer (*Dissertation: Bonn Univ.*, 1931, 46 pp.).—The inflection point in the load-deformation curve under compression of the 50:50 lead-tin alloy lies at 5.5 kg./mm.<sup>2</sup> and 7.2% reduction; addition of antimony changes these figures to 6.34 kg./mm.<sup>2</sup> and 10.8% with 4% antimony and to 9.3 kg./mm.<sup>2</sup> and 5.4% with 20% antimony. The 40:40:20 lead-tin-antimony alloy can be compressed by 25% without fracture, but on replacement of 5% of the antimony by 5% of copper fracture occurs at 7.2% reduction; hence copper increases the compressive strength, but reduces the plasticity. Replacement of part of the antimony in alloys with 3-5% copper by nickel improves the compression strength without decreasing the plasticity, but with more than 4% nickel the alloys tend to become hard and brittle, owing to the formation of Ni<sub>3</sub>Sn<sub>2</sub>. Small quantities of magnesium have a beneficial action on the bearing properties, whereas phosphorus produces brittleness. X-ray examination of tin-antimony alloys showed that the only compound formed is SnSb.—A. R. P.

**\*Electrical Conductivity and Equilibrium Diagram of Binary Alloys. IX.—The Magnesium-Thallium System.** G. Grube and J. Hille (*Z. Elektrochem.*, 1934, 40, 101-106).—Earlier investigations on the equilibrium diagram of the magnesium-thallium alloys by thermal and micrographic analysis led to

the assumption of 3 metallic compounds:  $Tl_3Mg_8$ ,  $TlMg_2$ , and  $Tl_2Mg_3$ , the first crystallizing direct from the melt, and the other two being formed from peritectic reactions. This assumption has been checked by a further investigation of the equilibrium diagram and a determination of the electrical conductivity of the alloys—of the whole range at 40°, 120°, and 200° C., of the magnesium-rich alloys at 80° and 160° C., and of the thallium-rich alloys at 280° and 360° C. Determinations were not obtained for the range 28.57–42.5 atomic-% of thallium. The curves show that the peritectic formation of the compound  $TlMg_2$  is always more or less complete. The conductivity falls very rapidly from pure magnesium to 8 atomic-% of thallium, and less so from pure thallium to 10 atomic-% of magnesium. From the shape of the curves, it can be deduced that the concentration of saturated solid solutions increases with the temperature. The thallium occurs in two crystal forms: up to 232° C., as the labile  $\alpha$  hexagonal form, and above this temperature as the stable  $\beta$ -modification with a regular face-centred lattice. Thermal analysis showed a eutectic at 405° C., with a composition of 27.27 atomic-% of thallium, corresponding with that of the compound  $Tl_3Mg_8$ , which is therefore considered not to exist. A compound,  $Tl_2Mg_3$ , containing 28.57 atomic-% of thallium was, however, observed through a peritectic reaction at 392° C. The compound,  $TlMg_2$ , was confirmed. The previously indicated compound,  $Tl_2Mg_3$ , through a peritectic reaction at 353° C. was found to be a eutectic containing 42.5 atomic-% of thallium, and a compound corresponding with  $TlMg$  (50 atomic-% thallium) was shown to be formed through this peritectic reaction. An eutectic containing 80 atomic-% of thallium is formed at 202° C.—J. H. W.

**The Diffusion of Mercury Drops on Rolled Tin Foils.** F. W. Spiers (*Proc. Leeds Phil. Lit. Soc.*, 1932, 2, 280–288).—See *J. Inst. Metals*, 1933, 53, 302.

—S. G.

**The Mechanical Properties of Two Heat-Resisting Alloys.** Y. Matsunaga (*Japan Nickel Rev.*, 1933, 1, 389–390).—[In English and Japanese.] Abstracted from *Kinzoku no Kenkyu*, 1931, 8, 340–349. See *J. Inst. Metals*, 1931, 47, 522.—W. A. C. N.

**\*Contribution to the Knowledge of the Iron-Nickel Alloys.** O. Dahl and J. Pfaffenberger (*Z. Metallkunde*, 1933, 25, 241–244; discussion, 245).—The decrease in permeability and increase in coercive force of quenched Permalloy on annealing at 300°–500° C. are combined with a decrease in the electrical resistance (Perminvar effect). This can be due to (a) precipitation of impurities from the iron-nickel solid solution at temperatures below 600° C., (b) formation of a crystal lattice with regular atomic distribution, or (c) a combination of (a) and (b), the effect being due to precipitation caused by the adjustment of the atoms to a regular distribution. X-ray analysis fails to give a clear decision, but that the first explanation cannot be correct has been shown by varying the proportion of impurities (oxygen, carbon) and by tests on vacuum-melted alloys of very pure iron and nickel. The second explanation thus seems to be more likely (see also *J. Inst. Metals*, 1932, 50, 733). In iron-nickel alloys containing 3–5% silicon or 15% copper, both phenomena appear when the quenched alloy is tempered at 400°–800° C. Temper-hardening of iron-nickel alloys is also possible after addition of beryllium, titanium, vanadium, or aluminium.—M. H.

**Special Nickel Alloys.** Anon. (*Metallbörse*, 1933, 23, 1053–1054, 1085–1086, 1117–1118, 1149–1150).—An alphabetical list of nickel alloys with details of their composition.—A. R. P.

**The Role of the Platinum Metals in Dental Alloys.** III.—The Influence of Platinum and Palladium and Heat-Treatment upon the Microstructure and Constitution of Basic Alloys. E. M. Wise and J. T. Eash (*Trans. Amer. Inst. Min. Met. Eng.*, 1933, 104, Inst. Metals Div., 276–303; discussion, 303–307).—For abstract of the paper see *J. Inst. Metals*, 1933, 53, 301. In the discussion C. S.

Sivil stated that addition of tin to gold-palladium alloys results in an alloy which oxidizes readily after being age-hardened, owing apparently to the presence of a tin-palladium compound; before age-hardening the alloy is resistant to oxidation. H. E. Stauss suggested that the formation of a platinum-copper compound was the cause of the great strength induced on age-hardening gold-silver-platinum-copper alloys. G. Masing expressed the opinion that, if the compound  $\text{AuPt}_2\text{Cu}_3$  is derived from  $\text{CuAu}$  by replacement of part of the gold by platinum, the gold and platinum atoms must be randomly distributed in the lattice, and therefore the Au:Pt ratio should change by solid solution formation. The authors, in reply, stated that the desirable properties of dental alloys necessitated generally the use of both platinum and palladium, the amount required being a function of the silver-copper ratio and of the total precious metal content; the hardening region stops in alloys with 30 atomic-% copper when the precious metal content exceeds 55 atomic-% in alloys containing equiatomic percentages of gold and palladium. Another example of loss of nobility when base metal hardeners are used is 18 carat nickel-white gold, which loses its nobility almost completely after heating for some time at an intermediate temperature, owing to the precipitation of a reactive phase. In palladium-gold-silver-copper alloys the hardening reaction is more nearly akin to the martensite transformation than to the Duralumin reaction. The alloy of composition  $\text{AuPt}_2\text{Cu}_3$  is actually a homogeneous solid solution with a face-centred tetragonal lattice,  $c/a = 0.98$ .—A. R. P.

\*The Freezing Temperatures of the [German] Standardized Soft Solders. O. Bauer and M. Hansen (*Z. Metallkunde*, 1934, 26, 39).—The temperatures of the primary, secondary, and tertiary crystallization of the antimony-tin-lead alloys with 90, 60, 50, 40, 33, 30% tin and about 1-3% antimony, have been determined.—M. H.

The White Alloys of Tin. II.—The Type Metals and Solders. Anon. (*Tin*, 1934, Jan., 6-9).—The properties required of alloys used for various type metals and for solders are described and the suitability of the lead-tin alloys for solders is discussed.—J. H. W.

\*Preparation of Non-Liquating Lead-Zinc Alloys. A. A. Botchvar and A. Ya. Ulyanov (*Zvetnye Metally (The Non-Ferrous Metals)*, 1932, (5/6), 28-32; *C. Abs.*, 1934, 28, 446).—[In Russian.] Alloys of zinc with 1% of lead can be prepared by dissolving the required amount of lead in the liquid zinc at high temperatures. On solidification, however, the lead separates out and liquation occurs. In order to prepare a uniform alloy free from liquation, the authors made 1-3% lead alloys by introducing lead chloride into molten zinc. On solidification the structure was found to be uniform, and the macrographs obtained by etching with hydrochloric acid showed uniform darkening, indicating the absence of segregation or liquation. The fact that the lead content of the ingots exceeded the solubility limit indicated that lead was present as an emulsion. On remelting, part of the lead separated out. Further experiments indicated that the liquation can be partly prevented by adding small amounts of magnesium, and wholly prevented by cadmium, iron, and copper. Tests by dissolving thin rolled plates in a 40-50% solution of ammonium nitrate showed some traces of coagulation of lead, although not sufficient to cause liquation. The existence of coagulation was interpreted as indicating the absence of a solid solution of lead in tin.—S. G.

\*On Porosity Phenomena in Non-Ferrous Alloys and Their Causes. Günther Schwietzke (*Dissertation: Tech.-Hochschule, Aachen*, 1931, 43 pp.).—Porosity may be due to shrinkage phenomena, or to gas absorption, or to both. Shrinkage and piping frequently cause voids and inverse segregation by reason of the pressure differences it produces in the partly solidified ingot. Gas porosity in non-ferrous metal is caused solely by absorption of hydrogen, carbon monoxide or sulphur dioxide. The action of hydrogen and sulphur dioxide on copper,



nickel, nickel-brass, brass, bronze, and "aluminium-bronze" has been examined. Sulphur dioxide produces porosity only in copper, nickel, and pure cupro-nickel, but not in the other alloys tested; the effect is due not to true gas absorption, but to the formation of sulphide and oxide in the liquid mixture and their reaction at the moment of solidification to re-form sulphur dioxide. Since the oxides of tin, aluminium, and zinc do not react with sulphides, the presence of these elements in copper and nickel alloys prevents the back-reaction, and hence sulphur dioxide causes no porosity. Hydrogen absorption is a much more common cause of porosity than has hitherto been thought; it may be produced by interaction of water vapour with the metal. Carbon monoxide is absorbed only by those metals which form carbides. Methods of avoiding gas absorption in melting and casting are discussed, and numerous photographs showing typical porosity phenomena are included.—A. R. P.

**\*On the Grain-Refinement of Various Alloys by Peritectic Reaction.** Ju-n Asato (*Kinzoku no Kenkyu*, 1933, 10, (11), 488-503).—[In Japanese.] In a former paper (*J. Inst. Metals*, 1933, 53, 11) it was shown that in any copper-rich alloys the crystal grains become very fine when iron or cobalt are introduced up to the peritectic point. It is now shown that a similar phenomenon occurs in alloys of the following systems: tin-copper, silicon-copper, zinc-copper, zinc-silver, cadmium-silver, antimony-tin, and aluminium-nickel.

—S. G.

**†Present-Day Problems in Theoretical Metallurgy.** Georg Masing (*Trans. Amer. Inst. Min. Met. Eng.*, 1933, 104, Inst. Metals Div., 13-47).—The Institute of Metals Division Annual Lecture, 1933. The following divisions of physical metallurgy are discussed in the light of modern knowledge: parting limits in alloys, ageing phenomena, transformations in the solid state. The lecture is illustrated by reference to the parting limits of gold alloys, the ageing of Duralumin, beryllium-copper and silver-copper alloys, and the austenite-martensite transformation in iron-carbon alloys.—A. R. P.

**\*The Mechanical Properties of Metals at Low Temperatures. II.—Non-Ferrous Metals.** E. W. Colbeck and W. E. MacGillivray (*Inst. Chem. Eng., Advance Proof*, 1933, Nov., 13 pp.; and (summary) *Met. Ind. (Lond.)*, 1933, 43, 579-582; discussion, 635-636).—Determinations have been made of the ultimate strength, proof stress, elongation, and reduction in area at temperatures between  $+20^{\circ}\text{C}$ . and  $-180^{\circ}\text{C}$ . of annealed copper, nickel, aluminium, 80:20, 55:45, and 30:70 cupro-nickel, "Y" alloy, 70:30 brass, nickel-brass, manganese-brass and "aluminium-bronze"; the results are shown in tables and graphs. An increase of 50% in the tensile strength of cupro-nickels irrespective of composition occurs between room temperature and liquid air temperature; the yield-point is also slightly raised and the elongation improved. The tensile strengths of brass and nickel-brass are about 40% greater at  $-180^{\circ}\text{C}$ . than at  $+20^{\circ}\text{C}$ ., and the elongation of brass is 40-50% greater. Aluminium remains very ductile over the whole range, and its strength increases by more than 100% on cooling in liquid air, whereas that of "Y" alloy increases by only 30%. "Aluminium-bronze" shows a marked improvement in ductility at  $-40^{\circ}\text{C}$ ., but again becomes less ductile at lower temperatures, whereas manganese-brass shows an improvement in ductility throughout the range. The notch toughness of all the metals tested except "Y" alloy is improved by immersion in liquid air, and part of this improvement is retained on return to normal temperature. Solder becomes extremely brittle at  $-180^{\circ}\text{C}$ ., due to the tin transformation.—A. R. P.

**\*A Contribution to the Determination of the Reflective Power of Metals in the Visible Region and in the Ultraviolet.** Konrad von Fragstein (*Ann. Physik*, 1933, [v], 17, 1-21).—The reflective power of silver, Magnalium, tellurium, and tantalum for light of wave-lengths between 5400 and 2500 Å. has been

measured. An alloy of Hochheim gave a reflective power of 70–80% in the ultra-violet; that of Magnalium is 70% for 4000 Å. and 43% for 2500 Å.—v. G.

**\*Measurements with the Aid of Liquid Helium. XXII.—(Resistance of Metals, Alloys, and Compounds.)** W. Meissner, H. Franz, and H. Westerhoff (*Ann. Physik*, 1933, [v], 17, 593–619; and *Wiss. Abhandl. Physikal.-Tech. Reichsanst.*, 1933, 17, 207–233).—Very pure niobium becomes superconductive at 9.2° abs. Arsenic–lead alloys form heterogeneous mixtures which become superconductive at the spring point (*sprungpunkt*) of lead provided that the lead forms a continuous skeleton for the passage of the current. Molybdenum–carbon alloys with 42–58 atomic-% carbon become superconductive at 8.5° abs., showing the presence of eutectic in this range; with less than 42 atomic-% carbon only a single phase (? solid solution) appears to exist. A large number of intermetallic compounds, which, according to Westgren, have an  $\epsilon$ - or  $\gamma$ -structure, show no superconductivity even at 1.3° abs. All the selenides and tellurides tested showed no sharp change in conductivity down to 1.26° abs., and among the numerous alloys tested very few showed superconductivity. —v. G.

### III.—STRUCTURE

(Metallography; Macrography; Crystal Structure.)

(Continued from pp. 126–129.)

**On the Observation of Opaque Materials by Means of Polarized Light.** O. Feussner. M. von Schwarz (*Z. Metallkunde*, 1933, 25, 313–314).—F. states that the greatest caution should be used in the interpretation of observations of metals and alloys by means of polarized light especially with regard to their physical state (internal stress, &c.). S. emphasizes the value of microscopic investigations with polarized light and F. gives further examples in support of his previous contention.—M. H.

**A Micrographic Study of the Decomposition of the  $\beta$ -Phase in the Copper–Aluminium System.** Cyril Stanley Smith and W. Earl Lindlieff (*Trans. Amer. Inst. Min. Met. Eng.*, 1933, 104, Inst. Metals Div., 69–105; discussion, 106–115).—For abstract of the paper, see *J. Inst. Metals*, 1933, 53, 187. In the discussion C. H. Mathewson suggested that the change from an acicular  $\beta$  to  $\beta'$  is in the nature of a recrystallization process without change of crystal structure; he also puts forward a theoretical crystallographic explanation of the various changes which occur in the transition of  $\alpha$  through the  $\beta$  phases to  $\delta$ . R. F. Mehl compares the  $\beta$  structure in copper–aluminium alloys with that of  $\beta$ -brass, and suggests that acicular  $\beta$  represents the formation of face-centred cubic  $\alpha$  from body-centred cubic  $\beta$ ; i.e. it is the reverse case crystallographically to the formation of martensite.—A. R. P.

**\*The Structure of the Gold–Copper Alloys.** W. Broniewski and K. Wesolowski (*Compt. rend.*, 1934, 198, 370–372).—While the compounds  $\text{AuCu}$  and  $\text{AuCu}_3$  are generally admitted to exist, there is some doubt as to  $\text{Au}_2\text{Cu}_3$ . To investigate the matter, the solidus and liquidus, arrest points, electrical conductivity at 0° C., temperature coeff. of electrical resistance between 0° and 100° C., the e.m.f. between –80° and +100° C., the percentage elongation between 17° and 218° and between 17° and 444° C. have been determined. The curve of solidification shows a minimum at 889° C. at about 80% of gold. The other curves show breaks corresponding with the compounds  $\text{AuCu}$  and  $\text{AuCu}_3$ , soluble in the metallic constituents. The phase  $\text{AuCu}$  has a martensitic structure, whilst all the other gold–copper alloys are polyhedral. No trace of the compound  $\text{Au}_2\text{Cu}_3$  indicated by Haughton and Payne was discovered in either the stable or the labile state.—J. H. W.

**A Study of Segregate Structures in Copper-Tin and Silver-Zinc Alloys.** Dana W. Smith (*Trans. Amer. Inst. Min. Met. Eng.*, 1933, 104, Inst. Metals Div., 48-61; discussion, 61-63).—For abstract of the paper see *Met. Abs.*, this volume, p. 128. In the discussion R. F. Mehl points out the analogy between the separation of  $\alpha$  from  $\beta$  copper-tin and silver-zinc alloys and of  $\alpha$  from  $\beta$  copper-zinc and copper-aluminium alloys, and advances arguments against the theory of needle growth proposed by D. W. S.—A. R. P.

**Segregate Structures of the Widmanstätten Type Developed from Solid Solutions of Copper in Zinc.** M. L. Fuller and J. L. Rodda (*Trans. Amer. Inst. Min. Met. Eng.*, 1933, 104, Inst. Metals Div., 116-128; discussion, 128-130).—For abstract of the paper see *J. Inst. Metals*, 1933, 53, 188. In the discussion R. F. Mehl reviews the effect of direction in determining the orientation of the segregate lattice with especial reference to face-centred cubic metals, and F. N. Rhines discusses some aspects of the X-ray detection of lattice distortions.—A. R. P.

**\*Mosaic Crystals of Zinc.** Harold K. Schilling (*Physics*, 1934, 5, 1-3).—Optically mosaic crystals of zinc have been grown by the Czochralski-Gomperz method. Three types have been distinguished, viz.: in the first, the components of the mosaic pattern have irregular boundaries and are small compared with the whole area; in the second, there are large areas bounded usually by straight lines and occasionally by smooth curves; in the third, the elementary mosaic areas are bounded by jagged, nearly parallel lines. During growth, mosaic crystals frequently change from one type to another.—J. S. G. T.

**\*The X-Ray Analysis of the Iron-Aluminium Alloys.** Atomi Osawa (*Kinzoku no Kenkyu*, 1933, 10, (10), 431-447).—[In Japanese.] In a previous paper (see *J. Inst. Metals*, 1933, 53, 616) O. put forward a revised diagram of this system. The present paper deals with the results of an X-ray analysis of the whole series of alloys. The Laue, rotation, and powder methods were used. The phases existing at room temperature are  $\alpha$ -iron,  $\text{FeAl}_2$ ,  $\text{Fe}_2\text{Al}_5$ , and  $\text{FeAl}_3$ , while the phase  $(\text{FeAl})_n$  is obtained by severe quenching in water of the alloy containing 57% iron from above  $1080^\circ\text{C}$ .—S. G.

**\*Crystal Structure of Copper-Tin Phases.** O. Carlsson and G. Hägg (*Z. Krist.*, 1932, 83, 308-317; *Sci. Abs.*, 1932, [A], 35, 1180).—The  $\epsilon$ -phase is rhombic, the elementary cell containing 32 atoms. The axial lengths (tin phase permitting) are:  $a = 5.510$ ,  $b = 38.18$ ,  $c = 4.319$  Å. The  $\eta$ -phase is hexagonal, with  $a = 20.95$ , and  $c = 25.43$  Å., and is related to the structure of NiAs. The so-called  $\gamma'$ -phase (homogeneous for about 22% tin at  $600^\circ\text{C}$ .) is hexagonal with  $a = 7.316$  and  $c = 7.854$  Å. The elementary cell contains 26 atoms, and the structure can be derived from a cubic space-centred lattice.—S. G.

**\*Crystal Structure and Ferro-Magnetism of the Manganese-Aluminium-Copper Alloys [Heusler Alloys].** O. Heusler (*Z. Metallkunde*, 1933, 25, 274-277; discussion, 277-278).—X-ray photograms of the quenched  $\beta$ -phase of the system copper-aluminium-manganese show that not only the aluminium atoms (cf. *J. Inst. Metals*, 1929, 41, 508) but also the manganese and copper atoms are regularly distributed in the lattice. At the composition  $\text{Cu}_2\text{MnAl}$  the aluminium and manganese atoms form a lattice of sodium chloride type with the copper atoms as a simple cubic lattice in its centre. Ageing for 1000-4000 hrs. at  $110^\circ\text{C}$ . changes the relative intensities of the super-structure lines and increases the electrical conductivity owing to completion of the regular atomic distribution, which is only 70-80% after quenching. Simultaneously an increase occurs in the magnetization at the absolute zero and in the Curie points. The composition  $\text{Cu}_2\text{MnAl}$  has the maximum of magnetization and the highest Curie point. H. concludes that any entry of foreign atoms into the three partial lattices of  $\text{Cu}_2\text{MnAl}$ , either by a change in concentration or by a disarrangement of the atoms, decreases the saturation



magnetization and the Curie point. The investigation has shown that a relation exists between the atomic distribution and the position of the Curie point.—M. H.

**The Lattice Structure of the Lithium-Cadmium Alloys.** E. Zintl and A. Schneider (*Z. Elektrochem.*, 1934, 40, 107).—A preliminary survey of the observations of previous workers on the lattice structure of the lithium-cadmium alloys has been undertaken.—J. H. W.

**\*X-Ray Study on Alloys of Silicon with Chromium, Manganese, Cobalt, and Nickel.** Bertil Borén (*Arkiv. Kemi Mineral. Geol.*, 1933, 11A, (10), 1-28; *C. Abs.*, 1934, 28, 85).—Four intermediate phases appear in the chromium-silicon system. The first,  $\text{Cr}_3\text{Si}$ , has cubic crystals with an edge of 4.555 Å. The second phase seems to be very complicated. It is not yet established, but the structure appears to have a tetragonal form. It appears only at temperatures below 1000° C. The third phase,  $\text{CrSi}$ , is analogous to  $\text{FeSi}$ . The length of edge of the cube is 4.620 Å. The last intermediate phase,  $\text{CrSi}_2$ , crystallizes hexagonally; the elementary prism contains 9 atoms and has the following dimensions:  $a = 4.422$  Å.,  $c = 6.351$  Å., and  $c/a = 1.44$ . In the manganese-silicon system 3 intermediate forms appear,  $\text{Mn}_3\text{Si}$ ,  $\text{MnSi}$ , and  $\text{MnSi}_2$ .  $\text{Mn}_3\text{Si}$  crystallizes hexagonally and has the following dimensions:  $a = 6.898$  Å.,  $c = 4.808$  Å., and  $c/a = 0.696$ . The elementary prism contains 16 atoms. The compound  $\text{MnSi}$  has an  $\text{FeSi}$  structure with a cube edge of 4.548 Å. The last phase,  $\text{MnSi}_2$ , belongs to the tetragonal system and has the following dimensions:  $a = 5.513$  Å.,  $c = 17.422$  Å., and  $c/a = 3.16$ . It is not analogous to  $\text{FeSi}_2$ . The cobalt-silicon system contains only 2 intermediate phases. The first,  $\text{Co}_2\text{Si}$ , crystallizes in the rhombic system; the dimensions of the parallelepiped are:  $a = 3.730$  Å.,  $b = 4.908$  Å., and  $c = 7.095$  Å. The compound  $\text{CoSi}$  has an  $\text{FeSi}$  structure with a cube edge of 4.438 Å. The nickel-silicon system was only partly investigated; the presence of a compound  $\text{NiSi}$ , analogous to  $\text{FeSi}$ , has been established. The edge of the elemental cube was established to be about 4.437 Å.—S. G.

**\*An X-Ray Analysis of the Crystal Structure of the Thallium-Tin Alloys.** H. J. C. Ireton, J. P. Blewett, and J. F. Allen (*Canad. J. Research*, 1933, 9, 415-418).—The tin lattice constant has a maximum value at the eutectic point (42.5% thallium), whilst the superconducting curve shows a cusp-shaped minimum at this point and a peak at the solubility boundary. When tin was added to thallium, a change from  $\alpha$ - to  $\beta$ -thallium was observed; this change is similar to that already noted in other alloys of thallium.—S. G.

**Total Secondary Electron Emission from Metal Faces.** S. Ramachandra Rao (*J. Annamalai Univ.*, 1933, 2, 249-257; *C. Abs.*, 1934, 28, 964).—An explanation was attempted of the peculiar shape of the total emission curves and the differences observed between polycrystalline and single-crystal faces as due to the absorption of the secondary electrons in the medium of the photoelectric target. Experimental results agree well with an equation derived for the ratio  $R$  of secondary to primary current. The equation holds for single-crystal faces and offers an explanation for the observed difference in  $R$  for the polycrystalline and single-crystal surfaces. The influence of adsorbed gases on  $R$  is discussed.—S. G.

**\*Contribution to Stereomagnetism. I.—On the Significance of Atomic Interchange for Magnetism. II.—On the Perminvar Problem.** O. v. Auwers and H. Kuehlewein (*Ann. Physik*, 1933, [v], 17, 107-120, 121-145).—Theoretical and experimental considerations on the relation between structure and magnetic properties with special reference to superstructure. The systems discussed are copper-gold, copper-antimony and copper-palladium, manganese-tin and manganese-nickel, iron-silicon, iron-gold, iron-tin and iron-cobalt, iron-nickel-cobalt, and  $\text{AlMnCu}_2$ .—v. G.

## IV.—CORROSION

(Continued from pp. 129-132.)

On the Anodic Behaviour of the Iron Group Metals [Iron, Cobalt, and Nickel]. Konrad Georgi (*Korrosion u. Metallschutz*, 1933, 9, 302-307).—A review of recent work, especially that of W. J. Müller and Erich Müller.

—A. R. P.

The Behaviour of Copper and Zinc and Their Alloys Towards Tap-Water. L. W. Haase (*Gesundheits-Ing.*, 1933, 56, 577-582; and (summary) *Metallwirtschaft*, 1934, 13, 29; *C. Abs.*, 1934, 28, 1004).—Waters containing dissolved oxygen will dissolve out zinc from brass pipes. The softer and more acid the water the more rapid is this action. The copper and zinc act as a galvanic element, the zinc going into solution. Copper is superior to other metals usually used for water pipes in physical and chemical properties and from the point of view of health. When copper is exposed to oxygen and moisture, cupric oxide is first formed, which in contact with metallic copper is then reduced to cuprous oxide. The very thin, very tenacious film of the latter which is formed serves to protect the copper from further attack. This process may require years in the atmosphere, is complete in a week or so in cold water, and in less time in hot water. Oxygen must be present. The patina, a porous layer of difficultly soluble basic copper salts subsequently formed (its composition depends on the salts present in the water), has no protective action, protection being due solely to the underlying cuprous oxide layer. This is proved by the fact that although a patina forms in oxygen-free water where no oxide can form, the copper continues to dissolve. In the absence of the oxide film the patina actually favours the solution of the copper, since its electrode potential is higher than that of copper. The formation of the cuprous oxide film may be hastened by the addition of nitrates, nitrites, and bicarbonates to the water. The rôle of protective metal coatings on other metals is discussed, especially those of tin and zinc. Corrosion of the more base metal may "ennoble" it, reverse the potential difference, and thus favour the solution of the other metal. The working of brass and copper pipes and methods of making connections are discussed.—S. G.

\*†The Corrosion and Protection of Magnesium and Its Light Alloys. Guy D. Bengough and L. Whitby (*Inst. Chem. Eng. Advance proof*, 1933, Dec., 13 pp.; and (summary) *Met. Ind. (Lond.)*, 1934, 44, 3-5, 83-85).—After reviewing recent work on the mechanism of corrosion of magnesium and its light alloys, an account is given of work carried out on the use of chemical dips and paint films as a protection of these metals against corrosion. None of the chemical treatments so far proposed affords satisfactory protection against sea-water, and no paint film applied to the clean surface is sufficiently non-porous and adherent to protect the metal for more than a very short period after immersion. Suitable combinations of the two processes have, however, been found which will afford adequate protection over periods of more than a year. The nature of the preliminary chemical treatment is of relatively minor importance compared with the type of paint used; alum-bichromate, neutral chromate, selenious acid, or the Jirotko dips are all equally satisfactory for preparing the surface for painting. The best paints are those prepared from sulphur-treated oils in which zinc oxide or chromate is used as pigment, and those prepared by incorporating aluminium dust in thermoprene resin. Better protection is afforded by the application of two dissimilar coats, e.g. two sprayed coats of quick-drying tung oil pigmented with zinc chromate may be followed by an outer coat of thermoprene resin containing zinc oxide or a spar varnish containing aluminium dust. Tables showing the loss in weight and reduction in tensile strength and elongation of various alloys of

the Elektron type after application of numerous types of protective coatings are given, together with 22 photographs showing the behaviour of these coatings during immersion in sea-water.—A. R. P.

**Checking Caustic Corrosion with Nickel and Its Alloys.** H. E. Searle and R. Worthington (*Chem. and Met. Eng.*, 1933, 40, 528–529).—Abstracted from a report issued by the Development and Research Department of the International Nickel Co.—F. J.

**White Rust on Zinc and Galvanized Iron.** —Schulz (*Metallwaren-Ind. u. Galvano-Tech.*, 1933, 31, 401).—The white efflorescence sometimes found on zinc articles after long storage is basic zinc carbonate produced by the action of atmospheric carbon dioxide and rain or condensed water on the zinc. Efficient aeration and precautions to avoid dew formation on the zinc prevent the development of white rust, since it forms only below the dew point.—A. R. P.

**\*Corrosion of Metals under the Influence of Some Petrols and Kerosenes.** N. I. Laduizhnikova (*Rep. Govt. Petroleum Res. Inst. (Moscow)*, 1932, 139–143; *C. Abs.*, 1934, 28, 449).—[In Russian.] Strips of various metals were immersed in petrol from the Urals containing 0.458% sulphur. It reacted considerably with lead and to a smaller degree with copper, brass, and iron, whilst its distillate did not attack brass or iron. A kerosene of the same origin which had 1.684% sulphur attacked all 3 metals to a much greater extent, whilst the distillate which contained 1.925% sulphur attacked copper and brass more vigorously and iron much less than the refined product. Cracked petrol from Baku attacked, after contact for 7 months, the following metals arranged in decreasing order of attack: lead, iron, copper, and brass. The attack was not so severe if the samples were kept in the dark. This phenomenon is explained by the presence of unsaturated compounds in the cracked petrols which are oxidized in the presence of metals, the latter acting as catalysts. This petrol also showed a higher acidity after the experiment. Baku kerosene had a corrosive action on the following metals, arranged in decreasing order of attack: lead, brass, copper, iron, and aluminium; the latter was not attacked during the 21 months' period of the experiments. This phenomenon was accompanied by an increase in the iodine number, the aniline point, and the acidity. Kerosene saturated with water attacked the metals in a more severe manner than dry kerosene.—S. G.

**\*Vinegar and Its Use in Canning, Especially of Marine Products.** Erling Mathiesen (*Tids. Hermetikind.*, 1933, 19, 319–322; *C. Abs.*, 1934, 28, 1114).—In canning sardines, mackerel, &c., the acetic acid concentration of the vinegar should not be more than 2%, giving about 0.5% in the product after storage; higher strengths detract from the flavour and are more corrosive. Tests were carried out with herring sardines, canned with 2.0, 2.5, 2.9, 3.8, 4.2, and 4.9% strengths of vinegar and stored for 2 years at 10°–15° C. At 2% the sardines kept well and there were no swells; above 4% all the cans were swells. For a like acetic acid concentration some cans were packed in strongly salted vinegar (15% sodium chloride), others with only 0.3% sodium chloride. Corrosion was more severe in the cans with 15% sodium chloride.—S. G.

**The Corrosion Problem.** O. A. Knight (*Mineral Ind., Pennsylvania State Coll.*, 1933, 3, (1), 4).—S. G.

**\*The Corrosion of Power Plant Equipment by Flue Gases.** Henry Fraser Johnstone (*Univ. Illinois Bull. No. 228, Eng. Exper. Station*, 1931, 9–120; and (abstract) *Power Plant Eng.*, 1932, 36, 179).—The corrosion of power plant equipment by flue gases depends chiefly on their sulphur content and the form in which it is present. The subject has been thoroughly investigated as it affects iron and steel equipment; very little information is given about non-ferrous metal corrosion. Pure lead and antimonial lead are attacked by flue gases at 95° C., showing that the concentration of sulphuric acid condens-



ing at this temperature is high, probably 65–80%. Chromium–nickel alloys with more than 20% of each of these elements are less resistant to the gases than stainless irons. Copper alloys are rapidly attacked by ferric sulphate solutions formed by action of the flue gases on the ferrous metal part of the plant. Methods of beneficiating coal by removal of ash and sulphur are discussed, together with methods of analyzing flue gases, and an account is given of the electrochemical theory of corrosion.—A. R. P.

**\*The Lowering of the Endurance Strength by Corrosion and Its Raising by Surface Pressure.** O. Föppl, O. Behrens, and Th. Dusold (*Z. Metallkunde*, 1933, 25, 279–282).—Abridged from papers by B. (see *Met. Abs.*, this volume, p. 62) and D. (*J. Inst. Metals*, 1933, 53, 603). It is concluded that the improvement of the fatigue strength and corrosion-fatigue by surface pressure is due to increase in density of the surface layers and not to the development of pressure stresses as suggested by Thum. (Cf. following abstract.)—M. H.

**Surface Compression and Corrosion-Fatigue.** Anon. (*Metallurgist* (Suppt. to *Engineer*), 1933, 9, 94).—A critical discussion of a paper by Föppl, Behrens, and Dusold. See preceding abstract.—R. G.

**Principles of Metallic Corrosion.** J. Glaymann (*Science et Industrie*, 1934, 18, 48–50).—From the simpler types of corrosion afforded by the action of aqueous acid solutions on metals, G. deduces a general explanation of corrosive attack, in accordance with the electrolytic theory of corrosion. A table is given showing the effect of metallic impurities on the action of dilute sulphuric acid on zinc.—P. M. C. R.

**The Electrochemical Theory of Corrosion.** Oliver P. Watts (*Trans. Electrochem. Soc.*, 1933, 64, 125–150; discussion, 151–153).—For abstract of the paper see *J. Inst. Metals*, 1933, 53, 635. The discussion between W. Blum and Oliver P. Watts centres round the function of electrons in corrosion phenomena and the meaning of “displacement” in electrochemical reactions.—A. R. P.

**Postscript on the Discussion of the Cover—or Relative—Theory.** W. J. Müller (*Z. Elektrochem.*, 1934, 40, 18).—Further comments on the criticism of E. Müller and K. Schwabe of W. J. M.’s theory of passivity. See *J. Inst. Metals*, 1933, 53, 92 and 555.—J. H. W.

## V.—PROTECTION

(Other than Electrodeposition.)

(Continued from pp. 133–134.)

**On the Protection of the Cooling Radiators of Internal Combustion Engines Against Corrosion.** W. O. Kroenig and S. E. Pawlow (*Korrosion u. Metallschutz*, 1933, 9, 268–273).—Addition of 0.05% of potassium dichromate to tap water prevents entirely corrosion of iron, brass, zinc, and 9% copper–aluminium alloy by the water at 20° C. When two or more of these metals are in contact with one another, and when the water is at 80°–90° C., complete protection is afforded by increasing the dichromate concentration to 0.2–0.25%; in the presence of 100–300 mg./litre of chloride ion at least 1% of dichromate is required.—A. R. P.

**Protection of Aluminium Against Corrosion.** José Ma. Fernández-Ladreda (*Anales Soc. Españ. fis. quim.*, 1933, 31, 776–778; *C. Abs.*, 1934, 28, 976).—The best protection in moist atmosphere is obtained by anodic treatment in an aqueous bath containing cryst.  $\text{Na}_2\text{CO}_3$  125,  $\text{Na}_2\text{CrO}_4$  8, concentrated  $\text{NH}_4\text{OH}$  25 c.c. per litre at 50°–60° C. for 10 minutes.—S. G.

**Cadmium Coating [Hot-Dipping] of Iron and Steel Parts.** Werner Fröhlich (*Metallbörse*, 1933, 23, 1437–1438, 1470–1471).—The hot-dipping process is described.—A. R. P.

**On the So-Called Homogeneous Lead-Coating Process.** F. Seehof (*Metallbörse*, 1933, 23, 1118-1119).—A brief account of the methods used in lead-coating iron vessels.—A. R. P.

**The Production of a Hard Undercoating on Copper Cooking Vessels Prior to Tinning.** Anon. (*Illust. Z. Blechindustrie*, 1934, 63, (3), 69).—An alloy of the composition pure tin 65-70, nickel 28-30, and silver 2-5%, is recommended for coating copper vessels before tinning. The fluidity of the alloy may be increased by the substitution of bismuth for a small proportion of the nickel. The process is stated to obviate the necessity for pickling and the possible overheating of the copper during tinning, with consequent formation of deleterious copper alloys.—P. M. C. R.

**Should Copper be Coated with Tin?** L. W. Haase (*Gesundheits-Ing.*, 1933, 56, 593-595; and (summary) *Metallwirtschaft*, 1934, 13, 29-30; *C. Abs.*, 1934, 28, 1004).—(Cf. Haase, *Met. Abs.*, this volume, p. 179.) Tin used to coat copper pipes carrying drinking water should be very low in lead. A high lead content decreases porosity and brittleness, but the lead tends to dissolve as the anode of a lead-copper galvanic element and render the water unsafe for drinking. In the copper-tin element formed at a break in the tin surface, the tin at first goes into solution, protecting the copper. Oxygen, carbon dioxide, and calcium salts attack the tin, forming an incrustation more electropositive than copper, so that the copper then dissolves. In contact with such waters tin-coated pipes deteriorate faster than uncoated pipes. Tin-coated pipes are recommended only for very soft cold water high in carbon dioxide and low in oxygen. Such waters will dissolve sufficient copper from uncoated pipes to acquire a taste. Heat-treatment of tin-coated pieces leads to the formation of a tin-bronze alloy, which, being more electropositive than tin, causes the latter to dissolve.—S. G.

**Galvanization, a Means of Protecting Ferrous Metals from Atmospheric Corrosion.** Marcel Lepingle (*Science et Industrie*, 1933, 17, 455-458, 495-498).—Cf. *J. Inst. Metals*, 1933, 53, 638. Methods of testing galvanized material are enumerated. L. considers immersion tests in aqueous copper sulphate to be of especial practical value. Methods of estimating the weight of deposited zinc are considered, and corrosion tests are described, with some observations on the influence of temperature and concentration; results are tabulated. Typical analyses of zinc from different sources are followed by solubility tables for "commercial" (99.95% pure) zinc in various reagents over stated periods. The influence on corrodibility and on fluidity of iron, bismuth, cadmium, aluminium, tin, lead, arsenic, and antimony is discussed, a number of equilibrium diagrams being reproduced.—P. M. C. R.

**The Effect of Composition and Pre-Treatment of Steels upon the Life of Protective [Zinc and Paint] Coatings.** Karl Daeves (*Trans. Electrochem. Soc.*, 1933, 64, 99-110; discussion, 110-112).—For abstract of the paper see *J. Inst. Metals*, 1933, 53, 638. In the discussion O. W. Storey stated that the amount of iron in the zinc coating affects its corrosion-resistance, and H. A. Nelson recommended the use of zinc dust as a primer in painting galvanized iron.

—A. R. P.

**Tentative Recommended Practice for Safeguarding Against Embrittlement of Hot-Galvanized Structural Steel Products and Procedure for Detecting Embrittlement (A 143-32 T).** — (*Amer. Soc. Test. Mat. Tentative Specifications*, 1933, 136-139).—See *J. Inst. Metals*, 1933, 53, 358.—S. G.

**Report of Sectional Committee [of A.S.T.M.] on Zinc Coating of Iron and Steel.** J. A. Capp and A. B. Campbell (*Proc. Amer. Soc. Test. Mat.*, 1933, 33, (I), 170-172).—See *J. Inst. Metals*, 1933, 53, 503.—S. G.

**Tentative Specifications for Zinc-Coated (Galvanized) Iron or Steel Farm-Field and Railroad Right-of-Way Wire Fencing (A 116-32 T).** — (*Amer. Soc. Test. Mat. Tentative Specifications*, 1933, 128-131).—See *J. Inst. Metals*, 1933, 53, 24-25.—S. G.

[Tentative] Revision of Standard Specifications for Zinc-Coated (Galvanized) Iron or Steel Farm-Field and Railroad Right-of-Way Wire Fencing (A 116-30). — (*Amer. Soc. Test. Mat. Tentative Standards*, 1933, 1067; and *Proc. Amer. Soc. Test. Mat.*, 1933, 33, (I), 1029).—See *J. Inst. Metals*, 1933, 53, 24-25.—S. G.

[Tentative] Revision of Standard Specifications for Zinc-Coated (Galvanized) Iron or Steel Barb Wire (A 121-30). — (*Amer. Soc. Test. Mat. Tentative Standards*, 1933, 1067; and *Proc. Amer. Soc. Test. Mat.*, 1933, 33, (I), 1029).—See *J. Inst. Metals*, 1933, 53, 25.—S. G.

Tentative Specifications for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Ordinary Uses (A 120-32 T). — (*Amer. Soc. Test. Mat. Tentative Standards*, 1933, 110-113).—See *J. Inst. Metals*, 1933, 53, 85.—S. G.

Tentative Specifications for Zinc-Coated (Galvanized) Iron or Steel Barb Wire (A 121-32 T). — (*Amer. Soc. Test. Mat. Tentative Standards*, 1933, 125-127).—See *J. Inst. Metals*, 1933, 53, 25.—S. G.

Tentative Specifications for Zinc-Coating (Hot-Dip) on Hardware and Fastenings (A 153-33 T). — (*Amer. Soc. Test. Mat. Tentative Specifications*, 1933, 132-135; and *Proc. Amer. Soc. Test. Mat.*, 1933, 33, (I), 583-586).—See *J. Inst. Metals*, 1933, 53, 503.—S. G.

Electromagnetic Thickness Tester for Corrosion-Resisting Coatings. E. Schweiter and S. Kiesshalt (*Werkstoffe u. Korrosion*, 1933, 8, 33-34; *C. Abs.*, 1934, 28, 450).—A method for determining thickness of non-magnetic coverings for steel or iron. An electromagnetic field is brought up to the coating by means of an electromagnet. The current required is measured, and from a calibration chart the thickness of the coating can be determined.—S. G.

The Protection of Pipes Against Soil Action. K. H. Logan (*Trans. Electrochem. Soc.*, 1933, 64, 113-124; discussion, 124).—For abstract of the paper see *J. Inst. Metals*, 1933, 53, 638. In the discussion Martin Kilpatrick suggested that the amount of organic acid in the soil plays an important part in determining the corrosion of underground pipes.—A. R. P.

The Protective Action of Zinc Plates in Boilers. C. O. Bannister and R. Kerr (*Trans. Liverpool Eng. Soc.*, 1933, 54, 15-36; discussion, 37-50; and (summary) *Met. Ind. (Lond.)*, 1932, 41, 441-443).—The use of zinc plates to protect boilers from corrosion is considered historically. B. and K. question the electrochemical basis of the method, considering that the zinc functions almost entirely as a deoxidant. Large-scale tests show that as between insulated and connected zinc plates, the difference in loss of weight is small, and can be accounted for by local electrolytic action on first making the connections. The influence of impurities, especially of iron and lead, on the efficiency of the plate is discussed. Analyses are given of deposits found on zinc plates after use.—P. M. C. R.

Metal-Spraying Technique. Anon. (*Illust. Z. Blechindustrie*, 1934, 63, (2), 35-37).—An account of the Schoop process. The construction and working of the pistol are described, and appropriate thicknesses of coating are indicated for different materials and purposes. Aluminium, zinc, tin, and lead are the coating materials most frequently used. A modification of the pistol is now applied to the spraying of metal powders.—P. M. C. R.

Petroleum Storage Tank Coatings and Corrosion in Oil-Cracking Installation. E. Perry (*Paint and Varnish Production Manager*, 1933, 9, (11), 10 *et seq.*; *C. Abs.*, 1934, 28, 300).—The corrosion of petroleum storage tanks by sour crude oils is outlined. The use of non-corrosive alloys is too expensive, and therefore paints must be relied on to prevent the corrosion. The characteristics of various coatings which have been tried are discussed.—S. G.

The Scientific Study of Protective Painting. S. C. Britton and U. R. Evans (*Trans. Electrochem. Soc.*, 1933, 64, 43-55; discussion, 55-58).—For abstract of the paper see *J. Inst. Metals*, 1933, 53, 556. In the discussion A. H. Sabin,



R. M. Burns, H. A. Nelson, and the authors discuss the nature of paint films and the function of the pigment in determining the protective action of the film.—A. R. P.

## VI.—ELECTRODEPOSITION

(Continued from pp. 134–138.)

**The Electrodeposition of Bismuth from Perchloric Acid Baths.** M. Harbaugh and F. C. Mathers (*Trans. Electrochem. Soc.*, 1933, 64, 293–298; discussion, 298).—For abstract of the paper see *J. Inst. Metals*, 1933, 53, 557. In the discussion C. A. Mann stated that good deposits of nickel, silver, and some other metals can be obtained from solutions of their perchlorates in organic solvents, and Colin G. Fink suggested that the perchlorate bath might be useful for depositing films of fusible alloys, e.g. on glass.—A. R. P.

**\*Theory of Chromium Plating.** E. Liebreich (*Z. Elektrochem.*, 1934, 40, 73–87).—The current–potential curves of plating in chromic acid have only two branches. The addition of another acid to the chromic acids causes a quartering of the curves by electrolysis, the branches being independent of the nature of the added acid. With platinum cathodes, another branch is formed with hydrogen evolution, but without deposition of chromium, at 0 v. A reduction can be observed with perchloric and phosphoric acids at very high concentrations, but not with boric acid. The fact of reduction is not a criterion of the practicability of chromium deposition; this depends much more on the solubility of the oxide, the structural nature of the salt formed, and the solubility of the metallic chromium formed in the foreign acid. The correspondence of the current–potential curves regardless of the different kinds of acids added is in contradiction to the hypothesis that the acids exert a perforating effect on the cathode film. The existence of such a film on a gold cathode can be detected and the film isolated. This causes the hydrogen evolution to suffer a considerable overvoltage. On platinum cathodes, on the other hand, where the film scarcely exists, hydrogen is evolved just as well without overvoltage. It can be shown that the temporary wandering of the potential to the negative is due to the saturation of the cathode with hydrogen—in the case of gold by means of the oxide film, and in the case of platinum direct—and not to the occurrence of a resistance to transition as a result of the formation of the oxide film.—J. H. W.

**\*The Influence of the Base Metal, Especially Nickel Plate on the Throwing Power of the Chromium Plating Bath.** Joachim Korpiun [with Ernst Vogel] (*Oberflächentechnik*, 1933, 10, 243–244).—The ordinary chromium-plating bath has a poorer throwing power on electrolytically degreased iron and copper than on metal which has been cleaned with whiting and then etched (iron with hydrochloric acid and ammoniacal ammonium persulphate for copper). On nickel plate the throwing power of the chromium-plating bath increases with the brightness of the nickel plate, being poor on matt nickel and good on bright nickel. Previous polishing of the nickel plate reduces the throwing power of chromium thereon, a polished matt nickel deposit giving a poorer throwing power than the original matt deposit.—A. R. P.

**\*Anodes for Chromium Plating in Solutions Containing Hydrofluoric Acid.** Erich Müller and Jön E. Vastdal (*Z. Elektrochem.*, 1934, 40, 14–18).—In the electrolysis of chromium from aqueous solutions of chromic acid, the metal is deposited on the cathode as trivalent  $\text{Cr}^{+++}$ . Prolonging the electrolysis to increase the yield has an injurious effect, and finally neutralizes the solution. Anodes should therefore be of such material that the  $\text{Cr}^{+++}$  is further oxidized to  $\text{CrO}_3$  by the current. The only material is lead, which serves as a general anode when the foreign ion is  $\text{SO}_4^{--}$ . If  $\text{F}^-$  is present, the pure lead anode exhibits a considerable transfer resistance, not when the electrolysis is continued steadily, but only when it is interrupted for a considerable period and then recom-

menced. The use of F' for chromium deposition has certain advantages, so that an endeavour was made to overcome the transfer resistance by alloying the lead with antimony or bismuth. A number of experiments were made with a bath containing  $\text{CrO}_3$  35,  $\text{H}_2\text{SO}_4$  0.09, and HF 0.06 gm. per 100 c.c., with a current density at the cathode of 5 amp./dm.<sup>2</sup> and at the anode 2.5 amp./dm.<sup>2</sup> at 20° and 40° C., the anodes consisting of pure lead or lead alloyed with 10, 20, or 30% of antimony or bismuth. Oxidation experiments were also made by gas analysis to determine whether these alloyed lead anodes were able to oxidize  $\text{Cr}^{+++}$  to  $\text{CrO}_3$  in chromic acid baths containing hydrofluoric acid, and whether they were sufficiently resistant to attack. As a result of these experiments, it was found that anodes of lead alloyed with 20–30% of antimony are suitable for use for this purpose.—J. H. W.

**Electroplating and Deposition of Metals [Chromium Plating].** H. S. Bavister (*J. Inst. Production Eng.*, 1933, 12, 435–472).—The process of chromium plating either direct or on intermediate deposits of copper and nickel is described in some detail.—J. C. C.

**Industrial Chromium Plating.—IX.** D. A. Nemser (*Iron Age*, 1934, 133, (5), 14–17, 76; (6), 18–19).—The properties of chromium plating for decorative and wear-resistance purposes are set out, and the technique of applying the coating to various tools, dies, gauges, &c., is described.—J. H. W.

**Chromium Plating.** M. Broich (*Metallbörse*, 1933, 23, 733–734, 765–766).—A discussion of modern plating practice.—A. R. P.

**Chromium Plating.** D. A. N. Sandifer (*Met. Ind. (Lond.)*, 1933, 43, 616–617).—Abstract of a pamphlet issued by Coleman and Appleby, Ltd., Birmingham.—J. H. W.

**Testing Chromium Plate for Resistance to Abrasion.** R. J. Piersol (*Metal Cleaning and Finishing*, 1933, 5, 411–414; *C. Abs.*, 1934, 28, 47).—An improved abrasion-testing machine is described.—S. G.

**Electrodeposition of Copper Sheets Not New.** R. H. D. Blattner. B. H. Strom (*Eng. and Min. J.*, 1934, 135, 89).—Letter to the Editor from B., criticizing a statement in a previous article that electrodeposited copper sheets had not been successfully produced until recently. S. replies that the advantage of the process in question is production of continuous strips of any desired width in the thinner gauges.—R. Gr.

**Method to Determine Copper and Nickel Plate Thickness on Steel, Brass, and Zinc Die-Castings.** Fred Carl (*Metals and Alloys*, 1934, 5, 39–42).—The article is plated for 20–30 minutes with copper from a cyanide bath, then for 1 hr. in an acid sulphate bath, set in solder and a section through the whole polished in the usual way, etched, and examined under the microscope, at 1000 magnifications. Zinc-base die-castings should be etch-polished with ammoniacal hydrogen-peroxide to obtain a well-marked distinction between the various layers. Examples of photomicrographs obtained in this way are shown.—A. R. P.

**\*Electrochemical Properties of Germanium.** J. Ivan Hall and Alfred E. Koenig (*Electrochem. Soc. Preprint*, 1934, April, 79–82).—Coherent cathodic deposits of germanium are obtained on freshly deposited copper cathodes at 78°–90° C. from 3*N*-potassium hydroxide solutions 0.025*M* with respect to germanium dioxide using current at 1.35–4.25 v., with a current density of about 0.2 amp./dm.<sup>2</sup>. Similar deposits can be produced on chromium, silver, and nickel, but the metal does not adhere well to platinum. Coarsely crystalline silver-grey deposits of germanium may be obtained by electrolysis of the dioxide dissolved in an equimolar mixture of potassium and sodium carbonates. The potential of the chain  $\text{Hg}|\text{Hg}_2\text{Cl}_2, \text{N-KCl}|\text{N-ZnSO}_4|\text{Ge}$  is 0.56 v. using electrodeposited germanium and 0.28 v. when germanium beads are used. Addition of sulphuric acid lowers the germanium potential against zinc sulphate solution. The potential of the chain  $\text{Hg}|\text{HgO}, \text{N-KOH}|\text{3N-KOH}, \text{GeO}_2|\text{Cu}$  is 1.407 v. at the point at which germanium commences to deposit on the copper. In sulphuric acid solutions the hydrogen overvoltage of germanium is 0.32 v.

Germanium replaces silver from silver nitrate solutions, but has no action on solutions of copper, mercury, lead, tin, arsenic, antimony, or bismuth salts.

—A. R. P.

**Electroplating Metals with Lead-Tin Alloys.** P. P. Belyaev and L. M. Berman (*Khimistroi*, 1933, 5, 2439-2442; *C. Abs.*, 1934, 28, 976).—[In Russian.] A discussion of general practice.—S. G.

**The Electrodeposition of Magnesium.** D. M. Overcash and F. C. Mathers (*Trans. Electrochem. Soc.*, 1933, 64, 305-310; discussion, 310-311).—For abstract of the paper see *J. Inst. Metals*, 1933, 53, 558. In the discussion Martin Kilpatrick suggested that the magnesium anode would dissolve in dimethylaniline if it were in contact with the glass of the cell. M. K. and other speakers also briefly discussed the mechanism of the reaction of magnesium with weak acids.—A. R. P.

**Electrodeposition of Iron-Copper-Nickel Alloys. III.—Deposition from Sulpho-Boro-Citrate Baths.** Lawrence E. Stout and Charles L. Faust (*Trans. Electrochem. Soc.*, 1933, 64, 271-282; discussion, 282).—For abstract of the paper see *J. Inst. Metals*, 1933, 53, 640. In the discussion L. E. Stout stated that X-ray examination of the deposits gave results which indicated that true alloys were formed although sufficient data to confirm this could not be obtained.—A. R. P.

**Throwing Power and Current Efficiency of the Nickel Plating Solution at Low and at High  $p_H$ .** Russel Harr (*Trans. Electrochem. Soc.*, 1933, 64, 249-263; discussion, 263-264).—For abstract of the paper see *J. Inst. Metals*, 1933, 53, 558. In the discussion E. M. Baker, Gustaf Soderberg, Russel Harr, and Colin G. Fink referred to various phenomena which occur on plating bent wires and suggested explanations of these.—A. R. P.

\*[Contribution] to the Knowledge of the Processes at the Cathode in the Electrolytic Deposition of Nickel. Kurt M. Oesterle (*Dissertation: Tech. Hochschule, Zurich*, 1928, 102 pp.).—Magnetometric measurements on nickel deposits of varying thickness obtained from numerous types of bath have shown that it is impossible to deposit nickel in a completely non-magnetic form, but that the magnetic properties vary considerably with the nature of the deposit, the highly lustrous deposit with a submicroscopic structure being less magnetic than that with a well-developed crystalline structure. Electrolytic nickel is in a metastable condition, and by heat-treatment can be rendered stable at the cost of losing its lustre. The lustrous, highly-dispersed deposits contain colloidal nickel hydroxide as dispersion medium, and are relatively free from hydrogen. The nickel hydroxide is produced near the cathode by local enrichment of hydroxyl ions, and is deposited on the cathode by cataphoresis; to produce a lustrous deposit this deposition must be retarded by the presence of a protective colloid. Changes in the condition of the dispersion medium produced by the composition and  $p_H$  value of the bath can alter considerably the nature of the deposit obtained.—A. R. P.

**The Adhesion of Electrodeposited [Nickel] Coatings to Steel.** A. W. Hother-sall (*Trans. Electrochem. Soc.*, 1933, 64, 69-83; discussion, 83-85).—For abstract of the paper see *J. Inst. Metals*, 1933, 53, 558. In the discussion in which W. Blum, Gustaf Soderberg, C. G. Fink, E. M. Baker, F. N. Speller, and A. W. Hother-sall took part, it was stated that no detachment of nickel deposits (0.001 in.) covered with chromium (0.00002 in.) from steel occurred after an elongation of 35% in the tensile test, and it was agreed that thorough cleaning of the basis metal was essential for good adherence, and that roughening of the surface did not necessarily improve the adherence of an electro-deposited plate. No really practical test for adhesion has yet been developed, and the fundamental nature of the bond between a surface layer and the metal itself is not yet completely understood.—A. R. P.

**Nickel Plating of Aluminium Needles.** Anon. (*Oberflächentechnik*, 1933, 10, 258).—The needles are 29-39 cm. long and 3-4 mm. in diameter and are



made of "mirror"-drawn aluminium wire. They are first pickled in 20% caustic soda then dipped in 1 : 1 nitric acid containing a few drops of hydrofluoric acid, and finally immersed in alkaline sodium zincate until they become coated with a bright zinc deposit. This is plated directly with nickel in a citrate bath.—A. R. P.

**A New Bath for the Direct Nickelling of Zinc.** George W. Nichols (*Trans. Electrochem. Soc.*, 1933, **64**, 265–270; discussion, 270).—For abstract of the paper see *J. Inst. Metals*, 1933, **53**, 559. In the discussion Martin L. Marcus stated that the iron and lead contents of the zinc affect the quality of the nickel plate; G. W. N. in reply stated that his experiments were conducted on pure zinc and on various zinc-base die-castings, equally good results being obtained in all cases.—A. R. P.

**\*On the Electrodeposition of Metallic Niobium.—II.** N. Isgarischev and G. E. Kaplan (*Z. Elektrochem.*, 1934, **40**, 33–36).—The method of making up the solution for the electrodeposition of niobium has been improved. It was found that in the electrolysis from alkaline or oxalic acid solutions, the niobium is only partly deposited on the cathode, a part forming a compound from which electrodeposition is not possible. In citric acid solutions, this does not occur to any considerable extent, owing to the regeneration of the solution. The separation of niobium and tantalum in the electrolyte, in the cathode deposit, and in the sediment has been carefully investigated.—J. H. W.

**Denture Bases Prepared by Electrolysis.** Frederick W. Frahm (*Brit. J. Dental Sci., Prosthetics Section*, 1933, **78**, 318–322).—Abstracted from *Dental Items of Interest (U.S.A.)*, **55**, (8). An elementary description of the operation of making denture bases by depositing silver or gold on plaster casts.—J. C. C.

**Theoretical Aspects of the Electrolytic Formation of Metallic Deposits.** M. Ballay (*Bull. Soc. franç. Elect.*, 1934, [v], **4**, 155–159).—Discussion of a paper by J. Salauze (*J. Inst. Metals*, 1933, **53**, 641). B. states that current distribution under working conditions does not accurately follow Ohm's law; he further criticizes the view advanced by S. of the function of gelatine in chromium plating.—P. M. C. R.

**\*Investigations on Electrolytic Deposition of Metals.** Ernst Rosenberg (*Dissertation: Univ. Berlin*, 1932, 26 pp.).—The factors affecting the crystal structure of electrolytic deposits of copper, tin, cadmium, and lead have been investigated. From cyanide solutions copper and cadmium are deposited in an extremely fine crystalline form, the individual crystals of which can scarcely be recognized under the microscope; deposits of tin from phosphate solutions and lead from alkaline solutions also consist of submicroscopic crystals. From simple salt solutions, however, all these metals are deposited in separate crystals, the size of which can readily be measured. The size of copper crystals deposited from sulphate solutions increases with rise in free acid concentration; similarly, the size of tin crystals deposited from stannous chloride solutions is greater the higher the concentration of the chloride and of free hydrochloric acid, but becomes smaller the greater the proportion of stannic chloride present. Addition of colloids reduces the grain-size of copper deposits, and this probably explains why stannic salts yield finer-grained deposits than stannous and why rise in temperature above 40° C. also produces finer-grained tin deposits, colloids being formed by hydrolysis in both cases. Increase in current density and stirring reduces the crystal size, and rise in temperature increases it in general. The nature of the basis metal and the condition of its surface play only a small part in determining grain-size; in the case of copper plate the crystals increase slightly in size according to the nature of the basis metal in the following order: copper, silver, nickel, chromium. Tin is deposited on chromium-plated cathodes in well-formed crystals. Deposits on etched surfaces of the basis metal are generally more uniform in crystal size than those on polished surfaces. The effect of acidity and tem-

perature in increasing grain-size is attributed to chemical dissolution of the finer crystals; in the case of copper this leads to the production of a high concentration of cuprous ions in the neighbourhood of the cathode which promotes growth of the larger crystals. Various theories on the mechanism of the electrodeposition of metals are discussed in the light of the results obtained in the practical work.—A. R. P.

**Measurement of Adhesion of Electroplates.** R. J. Piersol (*Metal Cleaning and Finishing*, 1933, 5, 503-506, 516-517; *C. Abs.*, 1934, 28, 976).—The physical nature of electroplate adhesion and the various methods for measuring it are discussed.—S. G.

**Measurement of Internal Stresses in Electroplates.** R. J. Piersol (*Metal Cleaning and Finishing*, 1933, 5, 456-459; *C. Abs.*, 1934, 28, 976).—Equipment and methods for determinations of stresses in electroplated coatings are described.—S. G.

**Discussion on the Removal of Electrodeposits by Stripping.** F. L. James, J. W. Perring, and G. E. Gardam (*Met. Ind. (Lond.)*, 1933, 43, 423-424).—Abstract of a general discussion held by the Electrodepositors' Technical Society; see *Met. Abs.*, this volume, p. 137.—J. H. W.

**Reducing the Toxicity of Cyanide Wastes [from Plating and Cleaning Baths].** E. F. Eldridge (*Eng. News-Record*, 1933, 111, 677).—Cyanide wastes from plating and cleaning baths may have their toxicity reduced by adding 10% more sulphuric acid than is necessary to decompose the cyanide and aerating to remove the hydrocyanic acid. Efficient means to remove the poisonous gas must be provided. An alternative method is to add 1.62 parts of potassium permanganate to 1 part of potassium cyanide in neutral or alkaline solution and allow to remain overnight. The solutions should be diluted to less than 500 p.p.m. of potassium cyanide before treatment.—J. C. C.

## VII.—ELECTROMETALLURGY AND ELECTROCHEMISTRY (Other than Electrodeposition and Electro-Refining.)

(Continued from p. 138.)

**\*Production of Pure Chromium.** P. P. Alexander (*Metals and Alloys*, 1934, 5, 37-38).—Chromium trioxide is sublimed at 200°-210° C. under a pressure of 1 mm. and the vapour passed through a tube at 850° C., whereby it is decomposed with the deposition of pure chromium sesquioxide. Two methods for the reduction of this oxide with hydrogen have been developed; in the first it is packed in thin layers between tantalum plates which are heated at 1000° C. in a quartz tube through which commercial hydrogen is passed. The tantalum absorbs 740 times its volume of hydrogen and the impurities in the gas pass out of the tube; when no more hydrogen is absorbed, the tube is closed and connected to a vacuum pump to reduce the pressure to 1 mm., whereby a sudden evolution of hydrogen from the tantalum takes place, the chromium oxide is reduced to metal, and the water vapour is driven out before the reverse action can occur. For complete reduction of chromic oxide with hydrogen at 1100° C.  $p_{H_2O}/p_{H_2}$  must be less than 0.001. The second reduction method consists in mixing the oxide with pure calcium hydride; reaction occurs at 470° C., and there is no risk of reversal of the reaction since the calcium reacts to form lime and hydrogen with the water as fast as it is formed by reduction of the chromic oxide. The reaction mixture of lime and chromium powder is treated with nitric acid to remove the lime, and the residual metal after drying can be pressed up, sintered, and worked into wire, &c., in the usual way. Thoria, beryllia, boron sesquioxide, and vanadium pentoxide can be reduced with calcium hydride in a similar way; the reaction in all cases is conveniently carried out in chromium-plated iron retorts.—A. R. P.

**The Story of Zinc.—IV.** H. R. Hanley (*J. Chem. Education*, 1934, 11, 111-113).—The electrothermic distillation and the electric smelting method for the production of zinc are described. The former process consists in sub-

jecting briquettes of the roasted ore and reducing carbon to heat produced by the passage of an electric current through them. The latter consists in smelting to form a matte and slag, distilling the zinc as an impure metallic powder, and refining. The uses of zinc are outlined.—J. H. W.

**\*On the Polarization Potential in the Cathodic Deposition of Zinc from Aqueous Solutions of Zinc Sulphate Containing Colloids.** Tomimatsu Isihara, Takeo Onoda, and Katsuo Umetu (*Kinzoku no Kenkyu*, 1933, 10, (8), 365-382).—[In Japanese.] Measurements have been made of the cathodic polarization potential, the anodic overvoltage, and the total polarization potential in the electrolysis at 35° C. of 0.5N-3.0N-zinc sulphate solutions containing glue or gelatin, using a platinized platinum sheet anode and a copper-plated platinum cathode covered with a thin zinc deposit. The effects of current density have also been determined. The results are shown in tables and graphs.—A. R. P.

**\*On the Theory of Passivity Phenomena. XXIII.—Further Investigations on the Passivity of Lead.** W. J. Müller and W. Machu (*Monatsh.*, 1933, 63, 347-366).—After an adequate cathodic pre-treatment of the lead surface, the  $i_0/t_p$  curve of a lead anode in sulphuric acid is given by the equations (a)  $\log t_p = -1.384 + 1.616 \log (i_0/F_0)$  for current densities of 1.22-0.03 amp./cm.<sup>2</sup> and (b)  $\log t_p = -0.767 + 0.872 \log (i_0/F_0)$  for current densities of 0.03-0.003 amp./cm.<sup>2</sup>. Evaluation of these curves in terms of Müller's covering theory of passivity indicates that the conductivity in the pores of the covering layer corresponds with a saturated lead sulphate solution, and is thus about 20,000 times smaller than that of ordinary accumulator acid. At the moment of passivation of a lead anode the uncovered surface amounts to  $10^{-2}$  to  $10^{-3}$  cm.<sup>2</sup>. The maximum current density rises linearly with the applied voltage to 40 amp./cm.<sup>2</sup> at 10 v., and at the limiting voltage of 2.1 is about 5 amp. These results indicate that two processes can occur at a lead anode according to the potential of the lead itself: (a) at a potential of -0.3 v. at the lead, which is raised to +1.8 v. by the film formed, the reaction corresponds with the normal anodic dissolution  $Pb \rightarrow Pb^{++}$  which leads to the formation of a lead sulphate film; and (b) at an electrode potential of +2 v. the lead itself is at potential of +1.8 v. corresponding with the reaction  $Pb \rightarrow Pb^{+++}$ , the latter being immediately hydrolyzed to peroxide, whereby the primary lead sulphate is also converted into peroxide.—A. R. P.

**Studies on Overvoltage. VI.—The Mechanism of the Transfer of Electrolytic Hydrogen and Oxygen Through Thin Sheets of Platinum and Palladium.** A. L. Ferguson and George Dubpernell (*Trans. Electrochem. Soc.*, 1933, 64, 221-247; discussion, 247-248).—For abstract of the paper see *J. Inst. Metals*, 1933, 53, 642. In the discussion A. H. W. Aten describes his work on the diffusion of hydrogen through palladium and its effect on the potential of the metal, and A. L. Ferguson mentions some peculiarities in the distribution of current in a long tube filled with acid and closed at each end by platinum electrodes.—A. R. P.

**Communication on the Electrolyte in the Measurement of the Resistance of Hydrogen-Containing Palladium Wire: Remarks on the Reply of Donald P. Smith.** C. A. Knorr and E. Schwartz (*Z. Elektrochem.*, 1934, 40, 36-38).—Reply to the criticisms put forward by Smith. See *J. Inst. Metals*, 1933, 53, 363, and *Met. Abs.*, this volume, p. 85.—J. H. W.

**Depolarization by Graphite Anodes in the Electrolysis of Aluminium Oxide.** M. de Kay Thompson and R. G. Seyl (*Trans. Electrochem. Soc.*, 1933, 64, 321-327).—See *J. Inst. Metals*, 1933, 53, 560.—S. G.

**Metallized Glass-Hydrogen Electrodes.** E. Newbery (*Trans. Electrochem. Soc.*, 1933, 64, 209-220).—See *J. Inst. Metals*, 1933, 53, 642.—S. G.

**Faraday and His Electrochemical Researches.** R. S. Hutton (*Trans. Electrochem. Soc.*, 1933, 64, 13-30).—See *J. Inst. Metals*, 1933, 53, 561.—S. G.



## VIII.—REFINING

(Including Electro-Refining.)

(Continued from p. 139.)

\***The Electrothermal Refining of Metals.** W. Kroll (*Metall u. Erz*, 1932, 29, 365-367).—In graphite resistance furnaces it is possible to separate by distillation the greater part of the lead from lead-tin alloys with relatively small contents of copper and antimony. For efficient separation of the metals a suitable dephlegmator must be used; the time and temperature required in the distillation may be reduced by lowering the pressure, *e.g.* to 0.1 mm., in the distillation vessel. The construction of suitable furnaces and rectifying and condensation apparatus is discussed, and some examples of the operation of the process are given. Starting with lead-tin alloys containing 30-50% tin, it is possible to obtain a distillate of lead with less than 5% tin and a residual metal containing more than 90% tin.—A. R. P.

**Notes on Purification of Electrolytes in Copper Refining.** E. S. Bardwell and R. J. Lapee (*Amer. Inst. Min. Met. Eng. Tech. Publ. No. 512*, 1933, 12 pp.).—The procedure adopted at the Great Falls electrolytic copper refinery of the Anaconda Copper Mining Co. is described. A portion of the electrolyte is removed daily, evaporated to a density of 1.45 in 28% chromium-steel pans, and set aside to allow the copper sulphate to crystallize. The mother-liquor is electrolyzed with insoluble anodes to recover the remaining copper and remove the arsenic and antimony, the resulting impure cathodes being re-electrolyzed in the ordinary tanks. The spent electrolyte is further evaporated to a density of 1.55 and cooled to separate nickel and ferrous sulphates, the residual acid being returned to the original tanks. Details of the operation of this plant over several years are tabulated and discussed.—A. R. P.

**Electrodeposition of Lead from Dithionate Baths.** R. L. Bateman and F. C. Mathers (*Trans. Electrochem. Soc.*, 1933, 64, 283-290; discussion, 291).—For abstract of the paper see *J. Inst. Metals*, 1933, 53, 562. In the discussion F. C. M., in reply to questions, stated that the reduction in acidity of the bath during use is due to chemical dissolution of lead from anodes by the dithionic acid assisted by atmospheric oxygen; manufacture of dithionic acid by electrolysis is unsatisfactory since a large amount of sulphuric acid is formed as a by-product.—A. R. P.

**The Electrolytic Refining of Mercury.** E. Newbery and S. M. Naude (*Trans. Electrochem. Soc.*, 1933, 64, 189-200).—See *J. Inst. Metals*, 1933, 53, 562.—S. G.

## IX.—ANALYSIS

(Continued from pp. 139-140.)

†**The Practical Works Application of Spectrographic Analysis.** H. Moritz (*Z. V.d.I.*, 1933, 77, 1321-1326).—A review, with numerous references.—v. G.

**Quantitative Analysis by X-Rays.** Anon. (*Metallurgist* (Suppt. to *Engineer*), 1933, 9, 84-85).—A review, dealing principally with a paper by Glocker, *Metallwirtschaft*, 1933, 12, 599. See *Met. Abs.*, this volume, p. 139.—R. G.

**Quantitative Estimation of the Impurities in Tin by Means of the Quartz Spectrograph.** C. Stansfield Hitchin (*Trans. Amer. Inst. Min. Met. Eng.*, 1933, 104, Inst. Metals Div., 353; discussion, 353-359).—For abstract of the paper, of which only an abstract is printed here, see *J. Inst. Metals*, 1933, 53, 259. The discussion, in which D. M. Smith, F. Twyman and A. Harvey, M. L. Fuller and G. W. Standen, G. Kuck, E. H. S. van Someren, H. E. Stauss, P. H. Brace and C. S. Hitchin took part, deals with various aspects of spectrographic

technique. The photoelectric photometer gives results which are 4-5% more accurate than the logarithmic sector, but the cost and time required for a determination are much greater. The arc method is considered to be more sensitive than the spark method for metal analysis, but the latter possesses advantages for Si, Sb, As, and B. Barrett's twin spark method is useful for quick, approximate determinations of constituents present in amounts of 5-20%. Ordinary C rods introduce Fe lines into the spectrogram, whereas Acheson graphite electrodes are free from this defect.—A. R. P.

**Tentative Methods of Chemical Analysis of Aluminium and Light Aluminium Alloys (B 40-33 T).** — (*Amer. Soc. Test. Mat. Tentative Standards, 1933, 213-228; and Proc. Amer. Soc. Test. Mat., 1933, 33, (1), 620-635.*)—**Silicon.** The sample is dissolved in an "acid mixture" of  $\text{H}_2\text{SO}_4$ ,  $\text{HCl}$ , and  $\text{HNO}_3$ , the residue fused with  $\text{Na}_2\text{CO}_3$ , taken up with  $\text{H}_2\text{SO}_4$ , and the  $\text{SiO}_2$  ignited and weighed, the weight of the residue not volatile in  $\text{HF}$  and  $\text{H}_2\text{SO}_4$  being subtracted for the final result. **Titanium.** The non-volatile residue from the above is fused with  $\text{KHSO}_4$ , taken up with  $\text{H}_2\text{SO}_4$ , reduced with  $\text{Zn}$ , and  $\text{H}_2\text{O}_2$  added. Standard titanium solution is run in to a dilute solution of  $\text{H}_2\text{SO}_4$  and  $\text{H}_2\text{O}_2$  until the colours match. **Copper.** (a) Electrolytic method (preferred). The sample is dissolved in  $\text{NaOH}$  and filtered, and the residue dissolved in  $\text{HNO}_3$  and electrolyzed. (b) Iodide method. The sample is dissolved in the "acid mixture" and  $\text{SiO}_2$  removed. The copper is separated with  $\text{H}_2\text{S}$ , dissolved in  $\text{HNO}_3$ , and titrated with standard  $\text{Na}_2\text{S}_2\text{O}_3$  in the usual way. **Manganese.** (a) Persulphate method (preferred). The sample is dissolved in the "acid mixture" and titrated with  $\text{NaAsO}$  in the presence of  $\text{AgNO}_3$  and  $(\text{NH}_4)_2\text{S}_2\text{O}_8$  in the usual way. (b) Bismuthate method. Excess  $\text{Fe}(\text{NH}_4)_2(\text{SO}_4)_2$  is added and titrated back with standard  $\text{KMnO}_4$ . **Iron.** This may be determined directly on the filtrate from the insoluble residue in the determination of Si by titration with standard  $\text{KMnO}_4$ . **Lead.** Add  $\text{H}_2\text{CO}_2$  to a neutral solution, pass  $\text{H}_2\text{S}$ , filter, redissolve in  $\text{HNO}_3$ , and electrolyze. Weigh as  $\text{PbO}_2$  (empirical conversion factor = 0.8643). **Magnesium.** Dissolve the sample in  $\text{NaOH}$  and electrolyze for 16 hrs. at 0.2 amp., using a mercury cathode. Precipitate the Mg. in the electrolyte as  $\text{Mg}_2\text{P}_2\text{O}_7$ . **Zinc.** (a) (<1%). Ammonium mercuric thiocyanate method. The Zn is precipitated with this reagent from an acid solution, an empirical factor being used for the calculation. (b) (>1%). Oxide method. Precipitate the Zn with  $\text{H}_2\text{S}$ , ignite at  $700^\circ\text{C}$ ., and weigh as  $\text{ZnO}$ . Dissolve in  $\text{HNO}_3$  and electrolyze for  $\text{PbO}_2$ . Calculate as  $\text{PbSO}_4$ , and deduct from the  $\text{ZnO}$ . **Tin.** Titrate with standard  $\text{KIO}_3$ .—J. H. W.

**\*A Contribution to Light Metal Analysis.** Th. Zürer (*Dissertation: Tech. Hochschule, Zürich, 1932, 59 pp.*)—Methods for the dehydration of magnesium chloride for electrolysis have been studied and a practical method for the dehydration of the dihydrate has been developed. Electrolysis of a potassium chloride-magnesium chloride melt containing only 0.06 mol. of aluminium chloride to 1 mol. of magnesium chloride yields an alloy containing more than 90% of aluminium. A method for the determination of aluminium and magnesium simultaneously by electrometric titration with alkali fluoride has been worked out.—A. R. P.

**[Tentative] Revision of Standard Methods of Chemical Analysis of Manganese-Bronze (B 27-19).** — (*Amer. Soc. Test. Mat. Tentative Standards, 1933, 1068; and Proc. Amer. Soc. Test. Mat., 1933, 33, (1), 1030.*)—A change is proposed in the description of the method for the determination of Mn by the persulphate method.—S. G.

**[Tentative] Revision of Standard Methods of Chemical Analysis of Brass Ingots and Sand-Castings (B 45-27).** — (*Amer. Soc. Test. Mat. Tentative Standards, 1933, 1068; and Proc. Amer. Soc. Test. Mat., 1933, 33, (1), 1030.*)—"The Tentative Method of Determination of Phosphorus in Copper-Base Alloys

in Ingot Form for Sand-Castings," B 45-33 T (see abstract, p. 195) is in effect a tentative revision of, and is intended when adopted to be incorporated in, the present Standard Methods B 45-27.—S. G.

**Influence of the Mechanical and Thermal Treatment of Inquarted Beads on Retention [of Silver by Gold after Parting].** Remarks on the Dry Gold Assay. August Hackl (*Chem. Zeit.*, 1933, 57, 723).—In the assay of Au bullion the inquarted bead after rolling into strip should be annealed before coiling for parting. The resulting Au roll retains only 0.4 mill. of silver, and no Au is lost in the  $\text{HNO}_3$ . If the Ag-Au strip is not annealed, the Au roll tends to break up and there is loss of finely-divided Au in the acid; despite the fact that the Au roll retains 4-5 mill. of Ag, the weight is usually 1-3 mill. less than the correct value. The surface appearance of the parted rolls shows the presence or absence of Ag; in the first case the metal has a bright yellow, lustrous surface and in the second case a dull yellow, matt surface.—A. R. P.

**Tentative Methods of Chemical Analysis of Metallic Materials for Electrical Heating (B 71-33 T).** — (*Amer. Soc. Test. Mat. Tentative Standards*, 1933, 269-285; and *Proc. Amer. Soc. Test. Mat.*, 1933, 33, (I), 648-664).—**Nickel.** Ni is precipitated and weighed as the dimethylglyoxime. For an accuracy greater than  $\pm 0.35\%$ , the precipitate is dissolved in  $\text{HNO}_3$ , boiled with  $\text{H}_2\text{SO}_4$ , and the  $\text{NiSO}_4$  solution made ammoniacal and electrolyzed. The increase in weight of the cathode gives the Ni, but for still further accuracy, the deposit is dissolved off the cathode with  $\text{HNO}_3$ , and the cathode washed and reweighed. **Chromium.** Persulphate method, titrating back excess  $\text{Fe}(\text{NH}_4)_2\text{SO}_4$  with 0.1N- $\text{KMnO}_4$ . **Iron.** Treat the sample with  $\text{HClO}_4$  in an Erlenmeyer flask fitted with a Mayer trap; precipitate the Fe with  $\text{NH}_4\text{OH}$  and  $(\text{NH}_4)_2\text{S}_2\text{O}_8$ , and filter (twice); dissolve the precipitate in  $\text{HCl}$ , boil, and add  $\text{SnCl}_2$  solution slowly. Finish the determination by the Zimmerman-Reinhardt method. **Manganese.** Dissolve the Fe precipitate in the preceding determination in  $\text{HNO}_3$ , add  $\text{H}_2\text{SO}_4$ , and boil. Add  $\text{Na}_2\text{BiO}_3$  and excess  $\text{Fe}(\text{NH}_4)_2(\text{SO}_4)_2$  and titrate back with standard  $\text{KMnO}_4$ . **Carbon.** Direct combustion of these alloys in oxygen at  $1100^\circ\text{C}$ . yields only part of the total C. An accelerator such as fine drillings of ingot iron or tin filings of known carbon content is therefore mixed with the sample. The evolved  $\text{CO}_2$  is absorbed in ascarite (asbestos impregnated with  $\text{NaOH}$ ) and weighed. For an accuracy greater than  $\pm 0.01\%$ , temperatures of  $1150^\circ\text{C}$ . or higher are used. **Insoluble residue.** Treat the residue insoluble in  $\text{HCl} + \text{HNO}_3$  with  $\text{HF}$  and  $\text{H}_2\text{SO}_4$ ; filter, ignite, and weigh any residue left. **Silicon.** Dissolve the sample in  $\text{HClO}_4$ ; ignite, and weigh the residue with the usual precautions. **Sulphur.** Evolution-titration method. This method depends on the evolution of practically all the S in the alloy as  $\text{H}_2\text{S}$ , when the alloy is dissolved in  $\text{HCl}$ , the absorption of the evolved gas in an ammoniacal solution of  $\text{CdCl}_2$ , and the determination of the S by titration with a standard solution of  $\text{KIO}_3$ , the decomposition of the alloy being effected in a Pulsifer flask. An optional (routine) variation of this method is described in *Amer. Soc. Test. Mat. Standards*, 1933, (I), 326, for plain carbon steels, and can be used for Ni-Cr alloys with the precautions here described. **Copper.** (a) 10-90%. Electrolyze direct. (b) Up to 5%. Separate with  $\text{H}_2\text{S}$  and with  $\text{NH}_4\text{OH}$  and electrolyze.—J. H. W.

**\*A Contribution to the Analysis of the Platinum Metals.** Max Zürcher (*Dissertation: Tech. Hochschule, Zürich*, 1929, 84 pp.).—Various qualitative tests for the Pt metals are described, and an account is given of attempts to determine the metals by electrometric titration with  $\text{SnCl}_2$ ,  $\text{TiCl}_3$ ,  $\text{KCN}$ , &c. A scheme for the gravimetric analysis of native Pt and osmiridium based on a combination of known methods is also given, as well as a microchemical method for Au. [Note by Abstractor: The method is tedious and possesses no advantages over well-known procedures.]—A. R. P.



\*On Studies of Eliminating Effects of  $\text{PO}_4$ -Radical in Qualitative Analysis. —II. Saburo Ishimaru (*Kinzoku no Kenkyu*, 1934, 11, (1), 38-42).—[In Japanese.] The use of Bi salts in the removal of  $\text{PO}_4'''$  from an analytical solution is preferred to the use of  $\text{Fe}'''$  or Zr salts, since the precipitate is not so voluminous and not amorphous; it therefore does not tend to occlude other constituents of the solution. The method is not applicable when much  $\text{Fe}'''$  is present, in which case the  $\text{Fe}'''$  salt method should be used.—A. R. P.

**Electrometric Methods in Physical and Analytical Chemistry.** Samuel Glasstone (*Institute of Chemistry*, 1934, 1-39).—A lecture, dealing mainly with the principles involved. A bibliography is attached.—E. S. H.

**Special Reagents for the Analytical Laboratory.** Anon. (*Chem. Age*, 1933, 28, 411; and (abstract) *Chem. Eng. Mining Rev.*, 1933, 25, 380).—Reagents are described for the detection and/or estimation of Mg, Mo, (trivalent) Sn, Cs, Ca, Cu, Pb, Hg, Cd, and Cr and for detecting and distinguishing between Al, Be, and Mg. The methods employed are briefly indicated in each case.—P. R.

**The Use of Organic Reagents for the Detection of Metals and Acid Radicles.** J. C. Giblin (*Proc. Inst. Chem.*, 1934, (1), 34-35).—A summary of a lecture recommending reagents for Mg, Na, K, Ba, Sr, Ca, Co, Ni, Al, Fe, Cr, Bi, Hg, Pb, Cu, Cd, Sn, As, Ag,  $\text{NO}_3'$ ,  $\text{PO}_4'''$ , and  $\text{Br}'$ .—E. S. H.

**Separation of Arsenic and Antimony from Tin.** P. Ed. Winkler (*Bull. Soc. Chim. Belg.*, 1933, 42, 503-518).—Modifications of the  $\text{H}_2\text{S}-\text{H}_2\text{C}_2\text{O}_4$  method are described. Addition of HCl assists in precipitation of the As and does not inhibit its separation.—A. R. P.

\*On the Precipitation Conditions of Zinc Sulphide and Aluminium Hydroxide and on a Method for the Gravimetric Separation of Zinc from Aluminium. J. N. Frers [in part with J. Kollwitz] (*Z. anal. Chem.*, 1933, 95, 1-36, 113-142).—For the precipitation of Zn with  $\text{H}_2\text{S}$  the sulphate solution, preferably free from chlorides, is treated with  $(\text{NH}_4)_2\text{SO}_4$  and made just acid to methyl orange. Precipitation occurs best in a hot solution containing filter pulp to assist in coagulation of the precipitate; the washed ZnS is ignited in  $\text{H}_2\text{S}$  for weighing. Al begins to precipitate by  $\text{NH}_4\text{OH}$  at  $p_{\text{H}}$  3-7 and redissolves in excess at  $p_{\text{H}}$  greater than 9, quantitative precipitation being best effected at  $p_{\text{H}}$  7-5 using phenol-red as indicator.  $\text{NH}_4\text{NO}_3$  and  $\text{NH}_4\text{Cl}$  have no effect on the precipitation, but the  $\text{Al}(\text{OH})_3$  contains a little basic sulphate if  $(\text{NH}_4)_2\text{SO}_4$  is present. The washing solution should contain 2% of an ammonium salt and should have a  $p_{\text{H}}$  of 7-5; the precipitate should be ignited at  $1200^\circ\text{C}$ . to expel  $\text{SO}_3$  and to convert the substance into corundum. To separate Zn from Al the sulphate solution containing 4%  $(\text{NH}_4)_2\text{SO}_4$  is adjusted to  $p_{\text{H}}$  2-8 using tropæolin 00 as indicator and the Zn precipitated with  $\text{H}_2\text{S}$  and washed with a similar wash water. The Al is then precipitated with  $\text{Na}_2\text{S}_2\text{O}_3$  and  $\text{NH}_4\text{OH}$  at  $p_{\text{H}}$  7-5.—A. R. P.

†The Detection and Determination of Small Amounts of Inorganic Substances by Colorimetric Methods. N. Strafford (*Institute of Chemistry*, 1933, 1-36).—A lecture. Recent work on the colorimetric determination and detection of Ag, Hg, Pb, As, Sb, Sn, Cu, Bi, Fe, Cr, Al, Ni, Co, Mn, Zn, and Mg is described and a brief account given of the theoretical aspects of the reactions involved; 45 references are given.—A. R. P.

**Errors in the Determination of Aluminium.** Rudolf Rinne (*Chem.-Zeit.*, 1933, 57, 992).—The presence of  $\text{NH}_4\text{Cl}$  is essential for complete flocculation of the  $\text{Al}(\text{OH})_3$  precipitate; 10 c.c. of saturated  $\text{NH}_4\text{Cl}$  solution should be added for every 150 c.c. of Al solution, followed by a reasonable excess of  $\text{NH}_4\text{OH}$ .—A. R. P.

**Colorimetric Determination of Aluminium with Eriochrome cyanin.** F. Alten, H. Weiland, and E. Knippenberg (*Z. anal. Chem.*, 1934, 96, 91-98).—The accuracy of the method is stated to be 5-100  $\mu$  grm. Analytical details are given.—A. R. P.

**\*Critical Investigations on the Colorimetric Determination of Minute Quantities of Aluminium.** Otto Moegen (*Dissertation: Univ. Würzburg, 1931, 1-19*).

—The scope and utility of the colorimetric methods for Al using tetrahydroxy-anthraquinone, aurintricarboxylic acid, and morin have been investigated. Good results are obtained only in the absence of other metals, especially Fe. The methods are unsuitable for the analysis of waters which have been in contact with Al unless they contain more than 0.005 mg. of Al per litre.—A. R. P.

**An Apparatus and Procedure for the Electrolytic Estimation of Arsenic.** Frank N. Moerk (*Trans. Electrochem. Soc., 1933, 64, 373-386*; discussion, 386-387).—For abstract of the paper see *J. Inst. Metals, 1933, 53, 647*. The discussion is concerned with details of the apparatus.—A. R. P.

**\*Quinaldinic Acid as an Analytical Reagent for the Determination and Separation of Copper, Zinc, Cadmium, and Uranium, and for the Colorimetric Determination of Iron.** Priyadarajan Ray and Makul Kumart Bose (*Z. anal. Chem., 1933, 95, 400-414*).—From hot, feebly acid solutions of Cu, Cd, and Zn salts quinaldinic acid precipitates crystalline, very insoluble salts of the type  $(C_{10}H_8NO_2)_2Me$ . The Zn and Cu salts contain 1  $H_2O$  and the Cd salt is anhydrous; after drying at 125° C. for 90 minutes the salts contain respectively 14.96% Cu, 24.63% Cd, and 15.29% Zn. Cu may be separated from Mn, Ni, and Co by precipitation in a solution containing 2-10 c.c. of 2N- $H_2SO_4$  per 150 c.c., and from Pb in a solution containing 4-8%  $CH_3CO_2H$ . Zn can be separated from Mn and the alkaline earths by precipitation in acetate solutions containing 5-10 c.c. of free acid per 200 c.c. U is precipitated as a flocculent yellow compound in the presence of 5-7 gm. per 120 c.c.; for weighing the precipitate is ignited to  $U_3O_8$ .—A. R. P.

**\*A New Method for the Volumetric Determination of Lead.** Mia-Nan Lu (*J. Chinese Chem. Soc., 1933, 1, 139-142*).—[In French.] See *J. Inst. Metals, 1933, 53, 320*. By adding excess of NaOCl and NaOH,  $Pb^{++}$  is precipitated as  $PbO_2$ , which is dissolved in HCl in presence of KI. The liberated  $I_2$  is then determined by titrating with  $Na_2S_2O_3$  and starch in the usual way. The procedure is applicable in presence of any metal that does not precipitate a peroxide when treated with NaOCl. Examples are given of the application of this method in presence of Cd, Sn, Zn, and Ag.—E. S. H.

**\*The Quantitative Determination of Lead with Picrolonic Acid.** Friedrich Hecht, Wilhelm Reich-Rohrweg, and Hermann Brantner (*Z. anal. Chem., 1933, 95, 152-163*).—The neutral  $Pb(NO_3)_2$  solution is treated hot with an excess of a 0.01N-solution of picrolonic acid, and after cooling to 0° C. the precipitate of  $Pb(C_{10}H_7N_4O_5)_2 \cdot 1.5H_2O$  is collected, washed with ice-water and dried at 110° C.; it contains 27.25% Pb.—A. R. P.

**\*Microdetermination of Magnesium as the Triple Ferrocyanide of Magnesium, Calcium, and Hexamethylenetetramine.** L. Debucquet and L. Velluz (*Bull. Soc. chim. France, 1933, [iv], 54, 1291-1292*).—Minute quantities of Mg may be determined colorimetrically by addition of  $FeCl_3$  to a solution of the compound  $[MgCaFe(CN)_6]_3 \cdot 4(CH_2)_6N_4 \cdot 40H_2O$ . This compound is obtained by adding the corresponding Ca compound in 20%  $(CH_2)_6N_4$  solution to the dry Mg residue.—A. R. P.

**\*A New Method for the Gravimetric and Volumetric Determination of Mercury.** G. Spacu and P. Spacu (*Z. anal. Chem., 1934, 96, 30-34*).—The hot, neutral or feebly acid  $HgNO_3$  solution is treated with a slight excess of  $KIO_3$ , and the  $HgIO_3$  precipitate is collected, washed with cold  $H_2O$ , then  $C_2H_5OH$  and  $(C_2H_5)_2O$ , dried *in vacuo* and weighed; it contains 53.42% Hg. Alternatively the excess  $KIO_3$  in the filtrate may be titrated with  $Na_2S_2O_3$ .—A. R. P.

**\*A New Method for the Indirect Volumetric Determination of Nickel.** Saburo Ishimaru (*Kinzoku no Kenkyu, 1933, 10, (10), 464-467*).—[In Japanese.] The Ni glyoxime precipitate is collected on a glass filter, washed, and dissolved in hot 6N- $H_2SO_4$  using a measured quantity of 0.1N- $K_2Cr_2O_7$  to oxidize the

glyoxime. The excess of  $K_2Cr_2O_7$  is then determined by means of  $FeSO_4$  and  $KMnO_4$ ; 1 c.c. of 0.1N- $K_2Cr_2O_7$  = 0.000240 grm. of Ni.—A. R. P.

**On the Microanalytical Determination of Palladium with Dimethylglyoxime, Methylbenzoylglyoxime, and Salicylaldoxime.** H. Holzer (*Z. anal. Chem.*, 1933, 95, 392-400).—Analytical details are given.—A. R. P.

**Tentative Method of Determination of Phosphorus in Copper-Base Alloys in Ingot Form for Sand-Castings (B 45-33 T).** — (*Amer. Soc. Test. Mat. Tentative Standards*, 1933, 247-249; and *Proc. Amer. Soc. Test. Mat.*, 1933, 33, (I), 638-640).—Add solutions of  $NH_4Cl$  and  $FeCl_3$  to a solution of the brass and filter. Dissolve the precipitate in  $HCl$ , pass  $H_2S$ , and filter. Oxidize the filtrate with  $KMnO_4$ , make just acid, add a special solution of  $(NH_4)_2MoO_4$ , and filter. Dissolve the precipitate in  $NH_4OH$ , make acid with  $H_2SO_4$ , pass it through a Jones reductor into a solution of ferric alum containing  $H_2SO_4$  and  $H_3PO_4$ , and titrate with standard  $KMnO_4$ .—J. H. W.

**\*A Gravimetric Method for the Quantitative Determination of Vanadium.** Margaret Merriman Parks (*Dissertation: Columbia Univ., New York, 1930*, 23 pp.).—In neutral solution  $NH_4VO_3$  is precipitated completely by  $[Co(NH_3)_6]Cl_3$  solutions as  $[Co(NH_3)_6](VO_3)_3$ , in ammoniacal solutions (0.5N- $NH_4OH$ ) as  $[Co(NH_3)_6]_4(V_2O_7)_3$ , and in slightly acid  $CH_3CO_2H$  solutions containing  $CH_3CO_2NH_4$  as  $[Co(NH_3)_6]_4(V_6O_{17})_3$ . Ignition of these precipitates affords respectively  $2CoO$ ,  $3V_2O_5$ ,  $4CoO$ ,  $3V_2O_5$ , and  $2CoO, 9V_2O_5$ . In ammoniacal solution the method separates V from  $As_2O_5$  and  $P_2O_5$ , and in acid acetate solutions from  $P_2O_5$ ,  $As_2O_5$ ,  $Fe^{+++}$ ,  $Cu^{++}$ , and  $Ca^{++}$ , but not from  $WO_4^{--}$ ,  $MoO_4^{--}$ , or  $Pb^{++}$ . Details of the separations are given.—A. R. P.

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

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

(Continued from pp. 140-141.)

**\*An Electrical Instrument for Detecting Invisible Flaws in Non-Magnetic Conductors such as Tungsten.** D. W. Dana (*Physics*, 1934, 5, 38-41).—The conductor, e.g., tungsten wire, is passed axially through a coil forming part of the tuned circuit of an oscillator. Any flaws in the conductor cause a change in the tuning, which is conveniently observed by heterodyning with a fixed frequency. By using high frequency of the order of 6000 kilocycles, the response is limited to surface flaws. It has been used in the factory inspection of tungsten wire, more especially for the location of longitudinal cracks, and is effective in the determination of asymmetry of coated wires.—J. S. G. T.

**\*A Thermoelectric Metal-Crystal Analyzer.** M. F. Hasler (*Physics*, 1934, 5, 9-14).—A device is described which enables the thermoelectric e.m.f. at room temperature, produced, for example by magnetization, at different points along a metal test-bar to be measured. A photographic device enables a complete thermoelectric record to be obtained.—J. S. G. T.

**New Equipment Facilitates Measurement of the Curie Point.** Anon. (*Automotive Ind.*, 1934, 70, 140).—A simplified apparatus is illustrated, with a brief summary of its method of operation.—P. M. C. R.

**\*Universal [X-Ray] Camera and Self-Indicating Rotating Crystal Camera.** Erwin Sauter (*Z. physikal. Chem.*, 1933, [B], 23, 370-378).—An improved modification of the X-ray goniometer previously described (*Met. Abs.*, this volume, p. 28) is described.—v. G.

**\*A High-Temperature X-Ray Camera for Quantitative Measurements.** A. H. Jay (*Z. Krist.*, 1933, 86, 106-111).—[In English.] See *J. Inst. Metals*, 1933, 53, 650.—E. S. H.



**\*Apparatus for Investigation of Fine Structure by X-Rays.** W. E. Schmid (*Z. physikal. Chem.*, 1933, [B], 23, 347-357).—A new combined X-ray tube and photographic apparatus is described in which only one focussing is necessary. The exposure required in each test is reduced to 10-40 minutes.—v. G.

**The Optics and Microscopy of Electrons.** E. Brüche (*A.E.G. Mitt.*, 1934, 2, 45-47).—The principle of the electronic lens is briefly explained and illustrated. Emanations from metallic surfaces, whether spontaneous or induced, are concentrated by such "lenses," and recorded photographically at magnifications of 50-100 diam.; the magnification can be further increased by optical methods. Specimen photographs of tungsten and platinum-rhodium (spontaneous emission) and of nickel (surface activated with barium) are shown.

—P. M. C. R.

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

(Continued from pp. 141-143.)

**Report of Committee E-1 [of A.S.T.M.] on Methods of Testing.** W. H. Fulweiler and R. E. Hess (*Proc. Amer. Soc. Test. Mat.*, 1933, 33, (I), 443-450).—See *J. Inst. Metals*, 1933, 53, 516.—S. G.

**Appendix [to Report of Committee E-1 of A.S.T.M. on Methods of Testing]. Report of Committee on Manual on Presentation of Data (1933).** — (*Proc. Amer. Soc. Test. Mat.*, 1933, 33, (I), 451-488).—Generally speaking, there are four general aspects of any problem involving the use of data: (1) statement of problem; (2) collection of information, old and new; (3) interpretation; (4) presentation. The three general objects of gathering engineering data are to discover: (1) physical constants and frequency distributions; (2) relationships, functional and statistical, between variables; (3) causes of the phenomena observed. The manual is principally concerned with the discussion of data relating to constants and their frequency distribution. Of the 47 sections, the first 36 are given over to considering the problem—given a set of  $n$  numbers containing the whole of the information under consideration, to determine how much of the total information is contained in a few simple functions of the numbers. The last 11 sections consider briefly the importance of using efficient functions to express the essential part of the total information, so far as its application is concerned. It is concluded that if a set of observations of a single variable is obtained under controlled conditions, most of the total information contained therein may be made available by presenting the following functions—the average, the standard deviation, the "skewness" (the extent to which the observations group themselves on one side or the other of the central value), and the number of observations. No single function is capable of giving much of the total information. The first, second, and fourth of the above functions give the essential information in most instances, but this is dependent on the true aim of the investigations. The subject is treated mathematically throughout.—W. A. C. N.

**Tentative Definitions of Terms Relating to Methods of Testing (E 6-32 T).** — (*Amer. Soc. Test. Mat. Tentative Standards*, 1933, 1059-1061).—The terms "elastic limit" and "yield-strength" are defined.—S. G.

**[Tentative] Revision of Standard Definitions of Terms Relating to Methods of Testing (E 6-30).** — (*Amer. Soc. Test. Mat. Tentative Standards*, 1933, 1087; and *Proc. Amer. Soc. Test. Mat.*, 1933, 33, (I), 1049).—The definitions of the terms "elastic limit" and "yield-strength" published under the title "Tentative Definitions of Terms Relating to Methods of Testing" (preceding abstract) are intended to be added when adopted to the present Standard Definitions E 6-30.—S. G.

**Tentative Definitions of Terms, with Units and Symbols, Relating to Magnetic Testing** (A 127-31 T). — (*Amer. Soc. Test. Mat. Tentative Standards*, 1933, 182-185).—See *J. Inst. Metals*, 1931, 47, 662.—S. G.

†**Study of the Constitution [of Metals and Alloys] by Means of Magnetic Methods. I.—Dia- and Paramagnetic Measurements.** A. Kussmann (*Z. Metallkunde*, 1933, 25, 259-266).—A review in which the fundamental conceptions (magnetization, susceptibility, &c), general regularities, methods of measuring, cause of para- and diamagnetism are discussed and some results are given of the application of magnetic measurements in the investigation of metallurgical problems, such as metallic state, relation between equilibrium diagram and magnetism, atomic conditions and valency relations in solid solutions, formation of crystal lattices with regular atomic distribution, kinetics of transformations (*e.g.*, in gold-copper alloys), detection of small amounts of iron in alloys, determination of limits of solid solubility of ferromagnetic metals in other metals, &c. Numerous references are appended.

—M. H.

**What Mechanical Tests are Worth While?** F. Nagler (*Canad. Mach.*, 1934, 45, (2), 22-24, 35).—A discussion of the applicability of several methods of mechanical testing. Tests to destruction under working conditions must frequently be replaced, on economic grounds, by small-scale mechanical tests: the development and increasingly representative character of the latter is considered in relation to a number of specific cases.—P. M. C. R.

**\*Procedure for the Study of the Distribution of the Elastic Deformation in Metallic Material Subjected to External Forces.** Albert Portevin and Michel Cymboliste (*Compt. rend.*, 1934, 198, 146-148).—The usual methods of investigating the distribution of permanent deformation are useless for elastic deformations, which are required for the evaluation of internal stresses and general calculation. To remedy this, the specimen is covered with varnish sufficiently adherent to show up the deformation of the metal, but sufficiently fragile to break when the deformation ceases to be elastic. Very fine cracks are produced, normal to the direction of maximum elongation and visible under suitable illumination. Illustrations are given of specimens pierced with holes and subjected to tension or bending. The varnish must be chosen according to the state of the surface of the metal, the temperature, and the sensitiveness required.—J. H. W.

**Photo-Elasticity—A Short Explanation of the Optical Principles Involved.** Thomas H. Evans (*Civil Eng.*, 1933, 3, 570-573).—J. C. C.

**Aeronautical Research in French Scientific Centres.** Pierre L glise (*Aeronautique*, 1933, 15, 258-260).—Researches in progress at the Institut Polytechnique de l'Ouest include photo-elastic observations, with the aid of a stroboscope, of the stress distribution in transparent test-pieces under the action of alternating forces, studies of the causes of failure of valve springs, and alternating torsion tests on wires at various temperatures. Brief notes are given on the results so far obtained, together with a photograph of the alternating torsion wire-testing machine.—J. C. C.

**An All-Weld Metal Test Specimen.** L. W. Schuster (*Mech. World*, 1933, 94, 833).—Abstracted from the report for 1932 of the British Engine Boiler and Electrical Insurance Co., Ltd. The preparation of a tensile test-specimen made of all-weld metal is illustrated and described.—F. J.

**A New Apparatus for Testing Welded Seams in Tubing.** J. F. Kesper (*Werkstatt u. Betrieb*, 1934, 67, 105-106).—The apparatus, which is inserted in the tube to be tested, permits the controlled admission of compressed air; the soaped joint is observed for signs of leakage. The method can be applied to straight or curved tubing, and is said to be suitable for tubes of all types.

—P. M. C. R.

**Magnetic Testing of Welded Seams.** Anon. (*Indian Eng.*, 1934, 95, (1), 16-17).—See *A.E.G. Mitteilungen*, 1933, (4), 133-135; and *J. Inst. Metals*, 1933, 53, 655.—P. M. C. R.

**Tentative Methods of Verification of Testing Machines (E4-33 T).** — (*Amer. Soc. Test. Mat. Tentative Standards*, 1933, 1047-1058; and *Proc. Amer. Soc. Test. Mat.*, 1933, 33, (1), 1013-1024).—See *J. Inst. Metals*, 1933, 53, 520.—S. G.

†**A Mechanically Recording Industrial Extensometer.** P. Chevenard (*Metallurgist* (Suppt. to *Engineer*), 1933, 9, 71-72).—A summary of a paper in *Rev. Mét.*, 1933, 30, 85. See *J. Inst. Metals*, 1933, 53, 518.—R. G.

**Tentative Method of Bend Testing for Ductility of Metals (E 16-31 T).** — (*Amer. Soc. Test. Mat. Tentative Standards*, 1933, 990-992).—See *J. Inst. Metals*, 1933, 53, 374.—S. G.

**British Standard Specification for Tensile Tests on Thin Metal Sheet and Strip [not Exceeding 0.08 inch (14 S.W.G.) in Thickness].** — (*Brit. Standards Inst. No. 485*, (Part I), 1933, 1-14).—The standard test-piece has a gauge-length of 2 in. and a width of 0.5 in., the shape of the ends being dependent on the manner in which the test-piece is held in the machine. Definitions are given for the values required to be determined by the tensile test. Suitable procedure for preparation of the test-piece is described. The accuracy and sensitivity of the test apparatus are dealt with and a suitable form of extensometer is described and illustrated. The importance of the method of mounting the test-piece in the machine is pointed out and the effect of speed of testing discussed. Sketches of two recommended methods of mounting test-pieces suitable for all types of material, are given.—R. G.

**Tentative Method of Test for Short-Time High-Temperature Tension Tests of Metallic Materials (E 21-33 T).** — (*Amer. Soc. Test. Mat. Tentative Standards*, 1933, 1030-1037; and *Proc. Amer. Soc. Test. Mat.*, 1933, 33, (1), 996-1003).—The method described covers short-time high-temperature tension tests of metals in the range room-temperature to 2000° F. (1095° C.). The specimen is of the usual 2-in. gauge length described in *Amer. Soc. Test. Mat. Standards*, 1933, (1), 949. The type of testing machine is not specified, but it must have the accuracy laid down by the A.S.T.M. An electric furnace is used, and must give a maximum variation over the gauge-length of not more than 10° F. (5.5° C.) for temperatures up to 1600° F. (870° C.), and not more than 20° F. (11° C.) for higher temperatures. The temperature of the test-piece is measured by a thermocouple of specified accuracy situated in one of 5 specified places. A survey of the temperature distribution throughout the test-piece is made on a special calibration bar of the same type and size as the test-piece. To ensure equilibrium, the heating period is not less than 1 hr. The details of the extensometer are not stated, but direct readings to 0.0002 in. or less must be obtainable. Details of testing to rupture and the methods of recording the data are described.—J. H. W.

**Tentative Methods of Compression Testing of Metallic Materials (E 9-33 T).** — (*Amer. Soc. Test. Mat. Tentative Standards*, 1933, 993-1000; and *Proc. Amer. Soc. Test. Mat.*, 1933, 33, (1), 959-966).—See *J. Inst. Metals*, 1933, 53, 517.—S. G.

**Flow in the Compression Test.** Hans Waschek (*Dissertation: Tech. Hochschule, Breslau*, 1933, 5 pp.).—Tafel's method of measuring the mean crystallite deformation in crystalline metals after compression has been simplified, and a theoretical explanation of the basic principles is given. Examples of the use of the method in determining the nature of flow in the compression of soft iron are included.—A. R. P.

**Torsion Impact Tester.** Anon. (*Instruments*, 1933, 6, 225).—A cross-arm attached to the specimen is suddenly pushed forward so that it engages with two striking bosses on a flywheel rotating at a known speed. After the specimen has broken, the speed of the flywheel is observed and the energy absorbed by the fracture determined.—J. C. C.



**Tentative Methods of Impact Testing of Metallic Materials (E 23-33 T).**

— (*Amer. Soc. Test. Mat. Tentative Standards*, 1933, 1010-1022; and *Proc. Amer. Soc. Test. Mat.*, 1933, 33, 976-988).—The notched-bar impact tests are intended for comparing the brittleness of metals, and the indications of the test should be stated only in terms of the total energy required to break a standardized specimen under standardized conditions, and cannot be generalized or applied quantitatively to other sizes or conditions. The 2 methods recognized as standard are the Charpy and the Izod tests. The machines are of the pendulum type, and the conditions governing the size of the machine and the linear velocity of the pendulum, and the dimensions of test-pieces for each type of test are given. Details are also given of correcting for friction and windage, operating the machine, and reporting tests. The theoretical basis of calibration and the method of carrying it out, determining the centre of percussion and the striking velocity, and general precautions to be taken are described. In an appendix, the applications of the impact test, its relation to service conditions, and the comparison of materials are discussed.—J. H. W.

**Tentative Methods of Rockwell Hardness Testing of Metallic Materials (E 18-33 T).** — (*Amer. Soc. Test. Mat. Tentative Standards*, 1933, 1001-1009; and *Proc. Amer. Soc. Test. Mat.*, 1933, 33, (I), 967-975).—The application for different purposes of the Rockwell scales A-G, using different penetrators and loads, and details regarding the penetrators, anvils, and test-pieces are described. The thickness of the test-piece must be such that under load, no bulge appears on the reverse side, the surface must be clean and free from coatings of any sort, and only single thickness is to be used. The procedure for testing, the adjustment and calibration of the apparatus, calibration with test-blocks, and the various precautions to be taken are described.—J. H. W.

**Relationship of Hardness Numbers.** W. E. J. Beeching (*Met. Ind. (Lond.)*, 1934, 44, 188).—Tests were carried out on carbon and nickel steels, brass, copper, aluminium, Duralumin, nickel, and cast iron to determine if a simple relationship between the Brinell and scleroscope numbers could be obtained. For the softer materials, the relationship was:  $S = \frac{B}{10} + 10$ , where  $S$  is the scleroscope number and  $B$  the Brinell hardness. For soft steels,  $S = 0.108B + 8$ , and for harder steels (where  $S > 55$ ),  $S = \frac{B}{10} + 15$ . These equations hold for all conditions of the materials (except case-hardening). Cast iron was found to be the exception, probably owing to the materials failing to "back up" at the edge of the indentation, and in this case,  $S = \frac{3B}{20} + 8$ .—J. H. W.

**Tentative Method of Test for Determining the Temperature-Resistance Constants of Resistance Alloys (B 84-31 T).** — (*Amer. Soc. Test. Mat. Tentative Standards*, 1933, 286-291).—See *J. Inst. Metals*, 1932, 50, 91-92. —S. G.

**Tentative Method of Analysis for the Particle Size Distribution of Sub-Sieve Size Particulate Substances (E 20-33 T).** — (*Amer. Soc. Test. Mat. Tentative Standards*, 1933, 1023-1029; and *Proc. Amer. Soc. Test. Mat.*, 1933, 33, (I), 989-995).—See *J. Inst. Metals*, 1933, 53, 520.—S. G.

**Tentative Definition of the Term Screen (Sieve) (E 13-28 T).** — (*Amer. Soc. Test. Mat. Tentative Standards*, 1933, 1062).—See *J. Inst. Metals*, 1928, 40, 620.—S. G.

### RADIOLOGY

**Recent Results of Radiometallographic Examinations of Castings.** René Leonhardt (*Rev. Fonderie moderne*, 1934, 28, 18-20).—The applications of the radiographic methods of examination to foundry work and examples of testing

castings by this method are described. For most foundry work, where the thickness of the metal is 100 mm., a 1-minute exposure with a 120-kv. tube using 5 ma. is required. Where the thickness varies greatly, many photographs from different angles may be required. With light alloy ingots up to 25 cm. thick, a 6-minute exposure with a 200-kv. tube at 10 ma. is used.

—J. H. W.

**X-Ray Examination for Metal Defects.** Lester E. Abbott (*Bell Laboratories Record*, 1933, 12, 72-76).—A general account of the production and interpretation of X-ray photographs of castings, welds, and forgings.—J. C. C.

**X-Ray Pictures of Weld Seams.** H. Halberstadt (*Forschungsarbeiten auf dem Gebiete des Schweissens und Schneidens*, 1933, 8, 71-76).—See *Met. Abs.*, this volume, p. 95.—H. W. G. H.

**X-Ray Diagnosis in Welding Technology.** H. Kochendörffer (*Forschungsarbeiten auf dem Gebiete des Schweissens und Schneidens*, 1933, 8, 76-81).—See *Met. Abs.*, this volume, p. 95.—H. W. G. H.

## XII.—TEMPERATURE MEASUREMENT AND CONTROL

(Continued from pp. 143-144.)

**Temperature Measurements with a Thermoelectric Pyrometer.** F. Schröder (*Metallbörse*, 1933, 23, 925-926).—The various commercial thermocouples and their sphere of usefulness are described.—A. R. P.

**Pyrometric Economies.** W. Bowen (*Edgar Allen News*, 1934, 12, 385-386).—A new thermocouple, called the Pyrofer, is described. It is comprised of 2 wires, one of which possesses heat-resisting properties greater than those of Nichrome, which forms the second element. This thermocouple is unaffected by carbon monoxide, sulphur dioxide, and other destructive gases in such quantities as are usually found in boiler plants and furnace chambers, and can be inserted without protection in a lead bath up to a temperature of 1400° C. Such a thermocouple has a life of 12 months at 1000° C., but temperatures up to 1450° C. can also be measured. Pyrofer wire is also used in the construction of a new resistance coil for resistance pyrometers used up to 1000° C.—J. W. D.

**\*The Temperature of the Beginning of Grey Radiation from Metals, Oxides, and Sulphides.** G. Tammann and W. Boehme (*Ann. Physik*, 1933, [v], 17, 863-868).—Temperature radiations become visible for annealed gold at 398° C., silver 378° C., platinum 376° C., and palladium 384° C. For the rolled metals the temperatures are about 10° C. lower in every case except silver where no difference is discernible.—v. G.

**A Metallographical Method for Determining Furnace Temperature Uniformity.** E. H. Dix, Jr., and A. C. Heath, Jr. (*Metals and Alloys*, 1934, 5, 10).—To determine whether a furnace is keeping a constant temperature, sheets of an alloy containing a eutectic which melts at the desired temperature are kept in the furnace and one is removed from time to time, polished, etched, and examined under the microscope to ascertain whether the eutectic colonies have melted. Thus for a temperature of 577° C. a 6% silicon-aluminium alloy may be used to maintain the furnace constant between 5° C. below and 3° C. above the melting point of the eutectic.—A. R. P.

**Use of the Thyatron for Temperature Control.** R. M. Zabel and R. R. Hancox (*Physics*, 1934, 5, 28-29).—A thermocouple is used in conjunction with a potentiometer, a photoelectric cell and a thyatron to control a furnace temperature. In an example, a temperature of 880° C. was maintained constant to within 0.06° C.—J. S. G. T.

**\*An International Comparison of Temperature Scales Between 660° and 1063° C.** Wm. F. Roeser, F. H. Schofield, and H. A. Moser (*Ann. Physik*, 1933, [v], 17, 243-250; and *Wiss. Abhandl. Physikal.-Tech. Reichsanst.*, 1933, 17, 177-184).—See *J. Inst. Metals*, 1933, 53, 569.—v. G.

## XIII.—FOUNDRY PRACTICE AND APPLIANCES

(Continued from pp. 144-146.)

†**Causes of Porosity in Non-Ferrous Castings.** J. H. Cheetham (*Iron Age*, 1934, 133, (5), 22-24; (6), 21-23; (7), 28-30, 72).—The functions of various classes of fluxes are explained and general rules for detecting flaws in metal castings are given, the chief causes being oxidized or gasified metal. The methods for increasing the density, promoting fluidity, purifying, and hardening the metal are described, and applications of numerous fluxes as deoxidizing and degasifying agents, and of nickel, manganese, and iron for increasing the density, are detailed. The action of individual purifying agents, "fluidizing" elements, and hardening agents are described. To eliminate porosity due (i) to occluded steam, regulate sand moisture and grains and pouring temperature; (ii) to occluded metallic oxides, change grade of metal mixture, method of charging, and pouring temperature; (iii) to gasification, change method of furnace operation, metal coring, grade of fuel or pouring temperature. The responsibilities for porosity troubles are allocated as 2% for metal storage, 18% to furnace operation, 65% to skimmers, and 15% to moulder.—J. H. W.

**Non-Ferrous Foundry Problems.** F. Dunleavy (*Found. Trade J.*, 1934, 50, 121).—Abstract of an address and discussion at the East Midlands Branch of the Institute of British Foundrymen.—J. H. W.

**Foundry Bronzes. I.—Gun-Metals. II.—Lead-Bronzes.** Anon. (*Found. Trade J.*, 1934, 50, 107 and 117).—Details of melting shop and foundry practice and of testing in the manufacture of gun-metal and lead-bronze castings are given.—J. H. W.

**Melting and Casting Bronze with Small Additions of Zinc (Gun-Metal).** Anon. (*Z. ges. Giesserei-Praxis: Das Metall*, 1934, 55, 11-15).—The melting and casting of bronzes containing 8-11% of tin, 1-3% of zinc, and relatively small amounts of lead, phosphorus, and nickel are described, and their applications are discussed. The best casting temperature is between 1130° and 1175° C., but may be increased to 1200° C. for complex castings. The effect of the zinc on the properties of the alloys and the functions of the other constituents are described.—J. H. W.

**Wright Develops Technique for Production Casting of Magnesium Alloy Engine Parts.** Joseph Geschelin (*Automotive Ind.*, 1934, 70, 124-127).—An account of the standardized production of magnesium alloy castings for aero-engine parts. Some core and tool forms are shown, and specifications are given covering the analysis and mechanical properties of castings, their heat-treatment, and the composition and quality of ingots. The causes of certain common defects are summarized, and methods of eliminating them are suggested.—P. M. C. R.

**"Aluminium-Bronze" Improved by Vacuum Die-Casting.** Anon. (*Iron Age*, 1934, 133, (4), 29).—In the vacuum process, molten "aluminium-bronze" is drawn by vacuum into a steel die from below the surface of the metal. The metal rises into the die in a smooth, continuous flow, without the effect of nozzling, spraying, or pouring. The aluminium oxide which forms on the advancing surface of the metal is deposited in a thin film on the walls of the die cavity. The flow of the metal into the die is maintained until the entire casting solidifies, thus eliminating porosity. Accuracy is said to exceed  $\frac{1}{2}\%$  of the linear dimensions.—J. H. W.

**Cast Metal [Dental] Bases.** Frederick W. Frahm (*Brit. J. Dental Sci., Prosthetics Section*, 1933, 78, 334-338).—Abstracted from *Dental Items of Interest [U.S.A.]*. The production of dental bases in tin, aluminium, or gold by gravity, centrifugal, or pressure casting is briefly described.—J. C. C.



**Report of Committee B-6 [of A.S.T.M.] on Die-Cast Metals and Alloys.** H. A. Anderson and P. V. Faragher (*Proc. Amer. Soc. Test. Mat.*, 1933, **33**, (I), 262-268).—See *J. Inst. Metals*, 1933, **53**, 522.—S. G.

**Patterns and Patternmaking.** E. Longden (*Trans. Manchester Assoc. Eng.*, 1932-1933, 149-183; discussion, 183-191).—An enumeration of the principal types of pattern work is followed by a discussion of costs. Standard British and American identification markings are tabulated, and the American Standard Trade Practice code is quoted. The making of certain patterns is then described in detail, with scale drawings.—P. M. C. R.

†**Rapid Moulding Apparatus.** U. Lohse (*Z. V.d.I.*, 1934, **78**, 56-58).—Apparatus and machines for rapidly preparing sand moulds for mass production castings are described.—v. G.

**The Properties and Testing of Foundry Sands.** Anon. (*Found. Trade J.*, 1933, **49**, 365-368; and *Met. Ind. (N.Y.)*, 1933, **31**, 368-369).—Full summaries of a circular letter issued by the U.S. Bureau of Standards. The general properties of moulding sands are discussed, and the methods for determining the moisture, fineness, compressive strength, permeability, and sintering temperature are described. Further examination comprises the hardness of mould surfaces, the requirements of core sands, shape of grain, chemical analysis, and grading. A table of sands for special uses with brass, aluminium alloys, iron, and steel is given.—J. H. W.

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

(Continued from p. 146.)

†**The German Scrap Metal Industry. Development and Economic Importance of the Recovery of Copper, Tin, Zinc, Lead, and Their Alloys from Scrap and Residues.** Arno Boss (*Dissertation: Univ. Berlin*, 1930, 82 pp.).—A comprehensive review of the subject from the German point of view with especial reference to its economic aspects.—A. R. P.

**The Treatment of Waste from Silver Manufacture.** Ernest A. Smith (*Met. Ind. (Lond.)*, 1933, **43**, 627-629; 1934, **44**, 6-8).—Summary of an address to the Sheffield Silver Trades Technical Society. The recovery of silver from waste in the solid and liquid form from the silver-ware and electroplating industries is described.—J. H. W.

#### XV.—FURNACES AND FUELS

(Continued from pp. 147-149.)

**The Design and Operation of Industrial Furnaces Using Gas, Oil, and Electricity.** S. N. Brayshaw (*Trans. Manchester Assoc. Eng.*, 1932-1933, 193-213; discussion, 213-226; and (summary) *Mech. World*, 1933, **93**, 262-263, 286-287, 317-319).—The economic use of heat-insulation is reviewed, a number of practical problems being discussed in detail. Heat losses due to convection currents and to radiation from the furnace are considered, and the causes of inefficient working of gas-fired furnaces using recuperators are analyzed. The management and operation of furnaces of all types is shown to affect their efficiency to a degree as important as their construction and design.—P. M. C. R.

†**Design of Town Gas-Fired Furnaces.** F. L. Atkin (*Gas J.*, 1934, 205, 104-107, and 152-152; discussion 153).—See *Met. Abs.*, this volume, p. 99.  
—J. S. G. T.

†**Vacuum Furnaces in Metallurgy.** N. A. Ziegler (*Metals and Alloys*, 1934, **5**, 5-9).—A review of recent developments in vacuum-melting technique.

Among the furnaces described are wire-wound and rod resistance furnaces, the Arsem furnace, and high-frequency induction furnaces.—A. R. P.

**Some Metallurgical Characteristics of Induction Furnaces as Determined by the Absorption of Oxygen by Molten Nickel.** F. R. Hensel and J. A. Scott (*Trans. Amer. Inst. Min. Met. Eng.*, 1933, 104, Inst. Metals Div., 139; discussion, 139-140).—For abstract of the full paper, of which only an abstract is printed here, see *J. Inst. Metals*, 1932, 50, 511. In the discussion F. R. Hensel said that the rate of chemical reactions in a 60-cycle furnace is 3-4 times as great as the ordinary high-frequency induction furnace, and that the limitations in melting and finishing a charge in the 60-cycle furnace could be overcome by developing a coreless induction furnace with a frequency range of 25-1000 cycles, the higher frequencies being used for melting and the lower for refining.

—A. R. P.

**\*On the Theory of the Coreless Induction Furnace.** Remus Basiliu Rădulet (*Dissertation: Tech. Hochschule, Zürich*, 1931, 82 pp.).—Mathematical. Expressions are derived for calculating the resistance and internal reactance of the coil and the thermal efficiency of high-frequency induction furnaces. The theoretical conclusions reached have been confirmed experimentally.—A. R. P.

**New Electric Furnace.** Anon. (*Eng. and Min. J.*, 1934, 135, 93).—A note on a new 25-lb. arc furnace, operating with direct, indirect, or submerged arcs.

—R. Gr.

### FUELS

**Incandescent Unit Automatic Gas Machine as Applied to Industrial Furnaces.** Anon. (*Fuel Economist*, 1934, 9, 202-203).—A self-contained unit gasifying machine having a nominal gasification capacity of 224 lb. of coal per hr. is described.—J. S. G. T.

**Tentative Method of Sampling Coke for Analysis (D 346-33 T).** — (*Amer. Soc. Test. Mat. Tentative Standards*, 1933, 466-470; and *Proc. Amer. Soc. Test. Mat.*, 1933, 33, (I), 715-719).—S. G.

**†The Meaning of Coal Analysis.** Clarence A. Seyler (*Fuel Economist*, 1934, 9, 171-173, 199-201).—The grouping of coals for purposes of firing, carbonizing, or gasifying is considered. Methods generally adopted are reviewed and the slackness prevailing in making an elementary analysis is commented upon. A chart representing the valuation of coal on a volatile matter basis is given. Procedure for the chemical analysis of coals is outlined, and the chief characters and uses of the different classes of coal are tabulated.—J. S. G. T.

## XVI.—REFRATORIES AND FURNACE MATERIALS

(Continued from pp. 149-150.)

**Report of Committee C-8 [of A.S.T.M.] on Refractories.** G. A. Bole and C. E. Bales (*Proc. Amer. Soc. Test. Mat.*, 1933, 33, (I), 279-284).—See *J. Inst. Metals*, 1933, 53, 524.—S. G.

**[Tentative] Revision of Standard Definitions for Clay Refractories (C 27-28).** — (*Amer. Soc. Test. Mat. Tentative Standards*, 1933, 1072; and *Proc. Amer. Soc. Test. Mat.*, 1933, 33, (I), 1034).—It is proposed to change the term "softening point" throughout to read "pyrometric cone equivalent." —S. G.

**[Tentative] Revision of Standard Method of Test for Refractory Materials Under Load at High Temperatures (C 16-20).** — (*Amer. Soc. Test. Mat. Tentative Standards*, 1933, 1070; and *Proc. Amer. Soc. Test. Mat.*, 1933, 33, (I), 1032).—It is proposed to add a second paragraph to the present paragraph (d) of Section 2.—S. G.

[Tentative] Revision of Standard Method of Test for Softening Point of Fire-Clay Brick (C 24-33). — (*Amer. Soc. Test. Mat. Tentative Standards*, 1933, 1070-1072; and *Proc. Amer. Soc. Test. Mat.*, 1933, 33, (I), 1032-1034).— It is proposed to change the title to read as follows "Standard Method of Test for Determining the Pyrometric Cone Equivalent of Fire-Clay and Fire-Brick," and also the term "Orton cones" to read "Standard Pyrometric Cones." Changes are also proposed to Sections 1, and 3(a), and an Appendix (cone temperature table) is added.—S. G.

Tentative Method of Test for Particle Size of Ground Refractory Materials (C 92-32 T). — (*Amer. Soc. Test. Mat. Tentative Standards*, 1933, 368-370).—See *J. Inst. Metals*, 1933, 53, 159.—S. G.

Tentative Method of Control Test for Resistance of Fire-Clay Brick to Thermal Spalling Action (C 38-33 T). — (*Amer. Soc. Test. Mat. Tentative Standards*, 1933, 371-372; and *Proc. Amer. Soc. Test. Mat.*, 1933, 33, (I), 689-690).—This method of control test is intended for determining the comparative resistance of high-duty fire-clay bricks to spalling action by subjecting them to repeated rapid temperature changes. It is not to be used as a suitability test, as experience has shown that results obtained are not comparable with those obtained in service on the same brand of brick. It is of value, however, as a control test in maintaining the uniformity of fire-clay bricks in so far as thermal spalling is concerned.—S. G.

## XVII.—HEAT-TREATMENT

(Continued from p. 150.)

Modern Heat-Treatment. Henry Toplis (*J. Inst. Production Eng.*, 1933, 12, 335-368).—Mainly of ferrous interest, but includes a brief discussion on the heat-treatment of aluminium alloys in salt-baths and electric air-circulation furnaces.—J. C. C.

## XVIII.—WORKING

(Continued from pp. 151-152.)

Power Economy Between Direct and Indirect Extrusion of Rods. Ch. Bernhoeft (*Z. Metallkunde*, 1933, 25, 315-316).—In the direct extrusion process the increase in the length of the ingot from 20 to 80 cm. increases the extrusion pressure by 83 atm. for copper, 122 atm. for aluminium, 70 atm. for 64 : 36 brass, 53.5 atm. for 63 : 37 brass, and 46-62 atm. for 57 : 41 : 2 copper : zinc : lead alloy. This is due to the additional surface friction which does not occur with indirect extrusion. The diameter of the extruded rod has no appreciable influence on this friction, and hence the power economy with indirect extrusion depends only on the length of the ingot and the nature of the alloy and is independent of the diameter of the extruded rod.—M. H.

Recent Progress in Non-Ferrous Seamless Tube Manufacture. Gilbert Evans (*Metallurgia*, 1934, 9, 117-120).—The mechanical and engineering progress in the manufacture of tube of various metals and alloys both by the rotary and extrusion processes are considered. One of the outstanding successes recently achieved has been in dealing with rotary piercing of 70 : 30 brass. Progress has also been made by the introduction in the rotary mill of motors of variable speeds and by the adoption of the expanding process and of automatic devices for handling the heated solid billet to the main rolls. Two new tube reducing processes are described in detail. In the extrusion process consideration is given to a recent type of mechanical power press, and to a new type of draw-bench which solves the problem of unproductive handling when it is used for bar drawing. Methods are suggested of reducing drawing



cost, and it is stated that during the past year scientific research and improvement in technique were more marked than in any previous period.—J. W. D.

**Modern Plants for Wire Drawing.**—II. Ch. Bernhoeft (*Z. Metallkunde*, 1934, 26, 19–23).—Cf. *J. Inst. Metals*, 1933, 53, 718. The plant required for the manufacture of copper wire 1.1–0.03 mm. in diam. is described. The construction of the drawing machines, and their performance, and the valuation and wear of the dies (diamond and artificial stones) are discussed especially from the economic point of view. The power requirements for the drawing of copper wires to 1.5–0.05 mm. with different reductions are tabulated. Valuable directions are also given for annealing and pickling the wire.—M. H.

**Effect of a Backward Pull Upon the Tension Required to Draw Wire.** Kenneth B. Lewis (*Wire and Wire Products*, 1934, 9, 55).—Discussion of a paper read by F. C. Thompson before the Iron and Steel Institute (see *J. Inst. Metals*, 1933, 53, 667). When a wire reaches the die already under stress, as in the case of a counterweighted wire, the pressure in the die, and therefore the work that the die must do, is decreased. This decrease is due to the pre-stressing, and is directionally proportional to it. Thus the counterweight is a “fixed charge,” whilst the amount of work in the die varies, whereas T.’s curves (but not his explanation) imply that the work in the die is constant, and that only a part of the counterweight affects the final tension.—J. H. W.

**Ears on Cupro-Nickel Cups.** W. H. Bassett and J. C. Bradley (*Trans. Amer. Inst. Min. Met. Eng.*, 1933, 104, Inst. Metals Div., 181–187).—See *Met. Abs.*, this volume, p. 151.—A. R. P.

[Joint Discussion on “Directional Properties in Cold-Rolled and Annealed Commercial Bronze” and “Ears on Cupro-Nickel Cups.”] E. M. Wise. W. B. Price. W. M. Peirce. E. H. Dix, Jr. A. J. Phillips. A. Phillips and C. H. Samans. R. L. Templin. R. S. Pratt. K. R. Van Horn. W. H. Bassett and J. C. Bradley (*Trans. Amer. Inst. Min. Met. Eng.*, 1933, 104, Inst. Metals Div., 187–193).—For abstract of the papers see *J. Inst. Metals*, 1932, 50, 661, and *Met. Abs.*, this volume, p. 151.—W. B. P. stated that he had observed 90° ears on 95 : 5 copper-zinc alloy sheets after a 97% reduction to 0.035 in. thick followed by an anneal at 700°–800° C.; the ears disappeared when the sheet was given an intermediate anneal at 550° C. at 0.064 in. W. M. P. stated that it was possible by special rolling to give zinc a preferred orientation which resulted in three sets of ears on cups drawn from the strip. E. H. D. observed that addition of only 0.2% of an element to aluminium will change the ears from 45° to 90°. A. P. and C. H. S. mentioned that they had found only very few examples of 45° ears on cupro-nickel made from new metals and deoxidized with magnesium, and suggested that the iron, magnesium, and manganese in cupro-nickel accounted for the peculiar earing properties of the alloy. R. L. T. expressed the opinion, based on much practical experience on aluminium, that the ratio of yield strength to ultimate tensile strength is important in determining the drawing and working properties of a metal. R. S. P. stated that the iron content of brass is not the cause of ears, but that this is due to re-annealing which increases the grain-size. K. R. Van H. considered that the evidence showed that favourable conditions for 90° ears in cupro-nickel were high annealing temperatures and low reductions (less than 65%); after more than 65% reduction the worked type of grain-alignment might be retained by heating at 700°–800° C., and therefore 45° ears were formed.—A. R. P.

**Fabricating Structural Aluminium.** C. G. Schade (*Eng. News-Record*, 1933, 111, 785–787).—Illustrated notes on the shearing, punching, bending, machining, and riveting of the aluminium work for the new floor of the Smithfield Street Bridge, Pittsburgh, Pa., U.S.A.—J. C. C.

**Accuracy in Airplane Propellers.—Making. I. and II.** Fred H. Colvin (*Machinist (Eur. Edn.)*, 1934, 77, 773–776, 812–814).—The machining and forging

of aeroplane propellers in chrome-vanadium steel and chromium-nickel-molybdenum alloy, and details of machining the "25 S.T." aluminium alloy blades and "beryllium-bronze" hub bushings are described and illustrated.

—J. H. W.

**Relief and Aluminium.** J. Bally (*Rev. Aluminium*, 1933, 10, 2279-2288).—Aluminium, by reason of its lightness and malleability, is very suitable for making reliefs, and a number of examples of its application in this province are given. Cracks in stamping aluminium paper may be due to using too thin a metal coating, or to glueing metal leaf on to metal leaf. In the latter case, the glue can only dry through very small perforations in the leaf, so causing the defects. Reliefs can be obtained by stamping, moulding, goffering, or dry flattening, and these methods are described and illustrated.—J. H. W.

**Machinability of Free-Cutting Brass Rod.**—II. Alan Morris (*Trans. Amer. Inst. Min. Met. Eng.*, 1933, 104, Inst. Metals Div., 216-220).—See *J. Inst. Metals*, 1933, 53, 215-216.—S. G.

**Machining Monel Metal.** Anon. (*Machinist (Eur. Edn.)*, 1934, 78, 17).—Details of turning, threading, drilling, reaming, tapping, and milling Monel metal are given.—J. H. W.

**\*Investigations on the Drilling and Reaming of Iron, Copper, and Aluminium Alloys.** Heinrich Schallbroch (*Dissertation: Tech. Hochschule, Aachen*, 1930, 23 pp.).—The power requirements with various types of tools are considered, as well as the effects of various lubricants and cooling media.—A. R. P.

**\*Researches on the Cutting Action of Planing Tools, by Microkinematographic, Photoelastic, and Piezoelectric Methods.** Makoto Okoshi and Shinji Fukui (*Sci. Papers Inst. Phys. Chem. Res. Tokyo* No. 455, 1933, 97-166).—(I.—) Fine squares of side 0.2 mm. were ruled on the vertical faces of specimens of cast iron, mild steel, brass, and copper, and the two-dimensional cutting action of a planing tool was studied by a microkinematographic camera. With brass the cutting action was of the slip type (cf. Rosenhain and Sturney, *J. Inst. Metals*, 1925, 34, 607) for tools of cutting angle both 60° and 90°. With copper a 60° cutting angle gave the flow type, and a 90° cutting angle a combination of flow and crack types. The deformation of the ruled squares showed that with a 60° cutting angle, the material was pulled upwards just below the point at which the tool was cutting, and downwards at a point in advance of the tool. With a 90° cutting angle the material was displaced downwards except just where the planed material was swept away upwards. In both cases the material was displaced horizontally in the direction of cut. The distortion of the squares was used to calculate the strains. (II.—) The stress distribution during machining was investigated photoelastically with phenolite models. In one method the tool was pushed into a suitably cut notch, and in another the actual cutting process was followed by photographs in polarized light with a microkinematographic camera. (III.—) By mounting a cutting tool in contact with a pair of quartz crystals, and using piezoelectric methods, it was possible to record on the microkinematographic film the actual force on the tool at the instant at which the photograph was being taken, and a simultaneous record of cutting force and cutting action was thus obtained. These showed a marked drop in cutting force each time a slip or crack was produced.

—W. H. R.

**Development of Cutting Tools.** Z. Jeffries (*Metal Progress*, 1933, 23, (2), 29-32).—Summary of an address to the Cleveland meeting of the American Society for Steel Treating.—P. M. C. R.

**The Drilling of Thin Sheet.** Anon. (*Werkstatt u. Betrieb*, 1934, 67, 114).—Modifications of tool and method are suggested for the clean and accurate drilling of sheet of thickness over and under 3.5 mm.—P. M. C. R.

## XIX.—CLEANING AND FINISHING

(Continued from p. 152.)

**Specifications for Chemicals Used in Cleaning Metals.** Edward B. Sanigar (*Monthly Rev. Amer. Electroplaters' Soc.*, 1933, 20, (3), 26–29).—Specifications are given for sodium hydroxide, carbonate, silicate, and phosphate, potassium hydroxide and carbonate, trichlorethylene and carbon tetrachloride.

—A. R. P.

**The Composition and Action of Metal Cleaners.** E. K. Strachen (*Metal Cleaning and Finishing*, 1933, 5, 426–429; *C. Abs.*, 1934, 28, 85).—A practical discussion of the composition and action of metal cleaners. General formulae are given.—S. G.

**Electrocleaning with Sodium Metasilicate.** F. J. Henning and T. K. Cleveland (*Metal Cleaning and Finishing*, 1933, 5, 497–502; *C. Abs.*, 1934, 28, 976).—Detailed directions are given for the preparation and operation of sodium metasilicate baths for the cleaning of various types of metal products prior to plating.—S. G.

**Blast Cleaning in the Metal Industry.** William A. Rosenberger (*Machinery* (N.Y.), 1934, 40, 353–356).—A general review. Reference is made to the "hydro-blast" method of removing cores from castings by the use of a stream of water at a pressure of 300–500 lb./in.<sup>2</sup> in place of an air blast.—J. C. C.

**Application of Electrochemically Produced Oxide Films on Aluminium (Eloxal Process) for the Colouring of Metals and for Galvanic Deposits.** Georg Buchner (*Oberflächentechnik*, 1933, 10, 233–234).—A brief description of the Eloxal process, its merits and uses.—A. R. P.

**\*Researches on the Grey Colouring of Copper Alloys with Arsenical Pickles.** Georg Gross (*Oberflächentechnik*, 1933, 10, 267–270).—Pickles for producing a grey finish on copper, bronze, and brass consist of arsenic trioxide, ferrous sulphate, and hydrochloric acid in various proportions; G. has determined the best. Some of the pickles previously recommended are efficient only after long storage, and others require to be boiled for 1 hr. and cooled before use. A solution of 11.2 grm. of ferrous sulphate crystals and 10.3 grm. of arsenic trioxide in 100 grm. of concentrated hydrochloric acid works well a few minutes after preparation, but improves on storage. If the ferrous sulphate is replaced by ferric sulphate, the pickle works rapidly and well from the moment of its preparation. The best grey is obtained at temperatures below 45° C., and matt copper surfaces colour better than polished ones. This pickle can be used for all brasses, bronzes, and Tombak.—A. R. P.

**Artificial Bronzing of Metals.** Eugen Werner (*Metallwaren-Ind. u. Galvano-Tech.*, 1933, 31, 423–424).—Several recipes are given for pickling baths which develop a bronze lustre on copper and brass.—A. R. P.

**How Attractive Finish Helps Metal Products Sales. Selecting the Proper Coating.—II.** Gustaf Soderberg (*Iron Age*, 1934, 133, (7), 22–24).—Tables give the kind of coating and whether acid or cyanide, application, usual thickness, protective value, appearance initially and after exposure, resistance to abrasion, and particulars of the process used. Practical considerations governing the selection of an electrodeposited coating for various purposes are discussed.

—J. H. W.

**The Grinding and Polishing of Aluminium.** Anon. (*Illus. Z. Blechindustrie*, 1934, 63, (3), 67–68).—Directions are given for the selection of suitable grinding wheels, running speeds, cooling media, and buffing wheels for aluminium and Duralumin. The composition of a polishing compound for exceptionally high finishes is given, and the ball-mill process for small work is described.—P. R.

**The Finishing of Metals Used in Aircraft.** Harold Crary (*Metal Cleaning and Finishing*, 1933, 5, 419–421; *C. Abs.*, 1934, 28, 82).—A description of the



operations and the equipment employed in the finishing of parts for all-metal aircraft.—S. G.

## XX.—JOINING

(Continued from pp. 152-154.)

†**Welding and Allied Processes for Engineering Purposes. I.-IV.** Arthur Stephenson (*J. Roy. Soc. Arts*, 1933, 81, 963-981, 986-996, 1002-1014, 1020-1042; and (abstract) *Welding J.*, 1933, 30, 83-84).—After a historical survey of welding, the sources of heat available are discussed, with details of the oxy-acetylene welding equipment and acetylene generators. Electrical arc welding is discussed, the atomic hydrogen process being dealt with in some detail. Electrical resistance welding and Arcogen welding are then described. Notes are given on the training and examination of operators, and practical notes are added on the preparation of the work, technique, suitability of electrodes, filler rods, fluxes, &c. The effect of welding on the properties of materials is discussed with particular reference to the production of local stresses in the vicinity of the joint and the influence of speed of welding. Destructive tests of the welded joint include tensile, bend, torsion, impact, malleability, hardness, static load, alternating stress, macro- or micro-examination, and chemical analysis. Among more recent testing methods are: (a) the hydrostatic or hydraulic test for closed containers, determining the pressure that can be withstood; (b) the acoustic test, in which the sound waves produced by hitting the article with a hammer are noted by means of a stethoscope; (c) the magnetic test, in which defects are indicated by lack of symmetry in the lines of force when the weld area is made part of the magnetic field and the surface of the weld is covered with finely-divided iron; (d) electrical tests, in which defects are discovered by differences in electrical potential or electrical conductivity; (e) radiographic tests, in which X-rays or  $\gamma$ -rays are used to show up defects by the usual photographic methods. Finally, the technique of metal cutting by blowpipe methods is described, and notes are given on the spraying of metallic coatings. Surface hardening by heat-treatment is discussed with reference to ferrous materials. The trend of development in welding, has been in the welding of thicker materials, which are beyond the practical limits for riveted joints, and in the welding of thin materials, which have always been unsuited to the riveted types of joints.—E. S. H.

**New Electric Resistance Welding Machines.** H. Wilbert (*Siemens Rev.*, 1933, 9, 87-89).—Reviews recent developments in resistance welding machines, including fully automatic interrupted current types, the latter being operated by grid-controlled rectifiers.—R. Gr.

**Automatic Carbon-Arc Welding Installations.** Carl Ritz (*Z. Flüg. u. Motor.*, 1933, 24, 571).—Abstract of a paper in *Siemens Z.*, 1933, 13, 150-153; see *J. Inst. Metals*, 1933, 53, 672.—P. M. C. R.

**Voltage Control of Arc by the Gaseous Envelope.** Robert E. Kinhead (*Welder*, 1933, 4, 350-351).—The rate of melting of an electrode is a function of electrode resistance of the welding rod which does not vary greatly with arc length.—H. W. G. H.

**The Influence of Welding and Protective Gas Flames on the Phenomena in the Welding Arc.** H. Münter (*Elektroschweissung*, 1933, 4, 149-151).—The effect of the gas flame in the Arcogen process is explained. The flow of gas is unfavourable to the arc, but the high temperature of the flame vaporizes the electrode coating, increasing the conductivity of the arc gap. The results are illustrated by oscillographs, which also show the advantage of a.c. over d.c. for this method of welding.—H. W. G. H.

**What Must the Welder Know of the Theory of the Arc?** Wilh. Fink (*Elektroschweissung*, 1933, 4, 181-187).—A comprehensive, though elementary,

review of arc theory, explaining arc and machine characteristics, the influence of open-circuit voltage, the differences between d.c. and a.c. arcs, and the cause of arc "blow."—H. W. G. H.

**The Relation and Application of Various Welding Processes.** P. L. Roberts (*Welding J.*, 1933, 30, 205-209; discussion, 209-210).—Paper read before the N.W. Branch of the Institution of Welding Engineers, March 22, 1933. See *Met. Abs.*, this volume, p. 41.—H. W. G. H.

**On the Study of Very High Temperature Flames.** G. Ribaud and D. Séférian (*Rev. Soudure Autogène*, 1933, 25, 2879-2889).—The atomic hydrogen and oxy-acetylene flames are studied spectroscopically in order to arrive at a clear conception of the dissociation reactions taking place. Although the information obtained is still incomplete, interesting results are obtained which help to supply the data necessary for calculating the temperatures of the flames thermodynamically. In the red part of the atomic hydrogen flame, the presence of a large quantity of atomic hydrogen is indicated, and, in the "fan," [OH] radicals with much less [H] are found. The calculated maximum temperature of the flame is 3725° C. The spectrum lines due to hydrocarbons and [OH], but none due to [H], are found in the normal oxy-acetylene flame, although dissociation of the molecular hydrogen undoubtedly takes place. The calculated maximum temperature of the flame, neglecting any hydrogen dissociation, is 4030° C.; if hydrogen dissociation is taken into account, a value of 2950° C. is obtained. This compares well with the experimentally determined figure of 3100° C. The white cone is found to consist of two regions, one surrounding the other.—H. W. G. H.

**Determination of Air Content in High-Purity Acetylene.** W. Scheruhn (*Autogene Metallbearbeitung*, 1933, 26, 296-299).—After a criticism of the methods suggested by Korschak and Schuftan, an apparatus is described in which the acetylene is absorbed by fuming sulphuric acid, which is claimed to give more rapid, consistent, and accurate results than acetone.—H. W. G. H.

**Fouling of the Blowpipe Tip by Metal Splashes as a Function of Manipulation.** W. Johag (*Autogene Metallbearbeitung*, 1933, 26, 246-248).—Ferrous welding only is considered. The advantage of rightward welding in avoiding fouling of the nozzle is demonstrated.—H. W. G. H.

**"Freezing-Up" of Oxygen Reducing-Valves.** A. Krauss (*Autogene Metallbearbeitung*, 1933, 26, 262-264).—The "freezing-up" is due to the small amount of water-vapour in cylinder oxygen. This should be removed by a drier placed between the cylinder and reducing-valve.—H. W. G. H.

**Pressure Regulators and Regulation Problems.** George M. Deming (*J. Amer. Weld. Soc.*, 1933, 12, (12), 22-33; and *Welding*, 1933, 4, 501-504, 545-546).—The principles underlying the design of pressure regulators are comprehensively reviewed. The deficiencies of the single-stage regulator and their elimination in the modern compound regulator are explained.—H. H.

**Method of Testing Regulators.** H. Lagarde (*Bull. Soc. Ing. Soudeurs*, 1933, 4, 979-989).—An apparatus is described by which a graphical indication is given of the characteristics of welding regulators. In effect, the low pressure is plotted against a high pressure, which is varied in a similar way to the conditions obtaining when a gas cylinder is gradually emptied. Examples are given of curves obtained with various types of regulator, and a new design is announced, in which the defects, shown by these curves, are claimed to be eliminated.—H. W. G. H.

**Pressure Booster Installations for Acetylene Distribution for Welding.** C. S. Milne (*Welding J.*, 1933, 30, 365-368).—The advantages of delivering acetylene at high pressure by pipe-line are enumerated, and the absurdity of the present regulations in this country is emphasized. Safety measures are discussed for the pipe-line, booster, gas-holder, and generator.—H. W. G. H.

**Investigations with Cooled Cylinder Acetylene.** Stephan Stark (*Autogene Metallbearbeitung*, 1933, 26, 378-379).—At low temperature, the solubility of acetylene in acetone is increased and, in practice, trouble may be experienced in cold weather if heavy demands are made on a cylinder. Details of tests at temperatures from  $-5^{\circ}$  to  $-15^{\circ}$  C. are given.—H. W. G. H.

**Generator Maintenance.** Anon. (*Oxy-Acetylene Tips*, 1933, 12, 277-278).—Detailed instructions are given for maintenance duties which are grouped into daily, weekly, quarterly, and annual inspections.—H. W. G. H.

**\*A Preliminary Research into the Effect of Heat-Treatment of Welds.** L. W. Schuster (*Proc. Inst. Mech. Eng.*, 1933, 124, 569-599).—Steel plates were joined by fusion welds using two or three runs of metal, and, after various heat-treatments, Izod tests were carried out on samples cut from different parts of the joint, so as to give the properties of the metal from the different runs. The details refer to ferrous metallurgy and do not call for abstraction.

—W. H.-R.

**†Method of Testing Welds. Position of the Work on Its Standardization.** G. Fiek (*Z.V.d.I.*, 1933, 77, 1005-1008).—A review of recent work of the Technical Committee for Welding Technique of the Verein deutscher Ingenieure covering mechanical testing, stress measurements, investigations by X- and  $\gamma$ -rays, and electrical and acoustic tests.—v. G.

**\*The Stresses in Fusion Joints.** E. G. Coker, R. Levi, and R. Russell (*Proc. Inst. Mech. Eng.*, 1933, 124, 601-633).—(1) One type of symmetrical butt joint for plates is made by chamfering both edges which are to be joined, and then filling up the V-groove with fusion metal, which in the process of welding gives a bulge of curved form on either side. A phenolite model of this shape was studied under stress in circularly polarized light. The maximum stresses occur at the junctions of the curved upper face of the joint with the plane faces of the joint, and the increase of stress intensity is 71%, whilst the effect of the sealing weld at the bottom is a similar local increase of 60% for the shapes studied. (2) A similar model was made of a butt weld with one jointing plane perpendicular to the faces of the plates, and the other inclined as in (1). The same general characteristics are found, but owing to the unsymmetrical nature of the joint the local intensities at the upper surface of the plates are nearly double those in the plates themselves, and an increase of 73% is found at the junction of the sealing weld. (3) A common joint is one in which two plates in line are connected by a lenticular section of fusion metal above, and by a cover-plate below, the latter being joined to the main plates by triangular sections of fused metal. A model of this type shows that when the cover-plate is of the same thickness as the main plates, the stress in the cover-plate is negligible, but with a cover-plate half the thickness of the main plate a larger fraction of the load goes through the cover-plate, and the joint is more efficient. In this kind of weld there are gaps of unjoined metal not penetrated by the fusion metal; these were represented by slits in the phenolite model, packed with a strip of phenolite to take the bearing pressure where necessary. The local stresses near the gaps are very high, and may be six times those in the main plates. (4) Models of double and single butt strap joints were also studied with both triangular and rounded fillets. When these results are used to estimate stresses in metallic welds, it must be remembered that the method assumes the joint and the plates joined to have the same uniform physical properties.—W. H.-R.

**Contribution to the Explanation of Fatigue Failure of Welded Joints.** W. Hoffmann (*Forschungsarbeiten auf dem Gebiete des Schweissens und Schneidens*, 1933, 8, 68-71).—A brief review of published information on the fatigue strength of welded joints leads to the conclusion that butt welds can be considered superior to riveted connections for resisting static stresses and equal to them for resisting reversed or repeated stresses.—H. W. G. H.



**Welds and Stresses.** H. N. Boetcher (*Welding Eng.*, 1933, 18, (9), 15-18).—A critical study of the effects of weld design and welding technique on internal stresses. Removal or distribution of stress by annealing and/or hammering is considered. The majority of service failures are said to be caused by fatigue, and the influence of defects in producing stress concentration is explained. [Note by Abstractor: Presumably steel welding only is considered.]—H. W. G. H.

**Stresses in Weld Seams.** L. v. Roeszler (*Autogene Metallbearbeitung*, 1933, 26, 273-279).—Two methods are described for determining the transverse and longitudinal stresses in butt-welds in sheet. For steel, the longitudinal stresses are found to be considerable, and are greatest with arc welding, using bare wire electrodes, and least with "left-hand" acetylene welding. The transverse stresses are least with bare-wire arc welding and greatest with "left-hand" acetylene welding. These results are to be related to the conditions of experiment, which are given in detail.—H. W. G. H.

**\*Study of the Internal Tensions in Welds.** E. Varriot (*Arts et Métiers*, 1934, 87, 1-6).—The study of the tensions remaining in autogenous welds after cooling, and especially in those executed with an electric current, depends on the following 5 determinations: (1) the heat applied to the point in question; (2) the mass of the elements involved in this application; (3) the division of the temperatures in these elements; (4) their cooling curves, and (5) the electrical resistance of the metals at different temperatures. The methods of making these determinations are described, and their bearing on the main problem is discussed.—J. H. W.

**Homogeneous Joints in Structures.** Everett Chapman (*Welding Eng.*, 1933, 18, (12), 20-24; and *Welding*, 1933, 4, 541-544; 1934, 19, 23-24).—Stress concentration in welded joints may result from incomplete penetration, under-cutting, overlapped weld metal or convex fillets. Examples of these faults are illustrated, with photo-elastic studies showing the distribution of stress. It is shown that, in many cases, the condition of uneven stress may be relieved by removing weld metal. The effects of contraction, damage caused by the heat of welding, and heat-treatment are discussed with reference to welds in steel.—H. W. G. H.

**Concentrated Stresses in Welded Structures.** Robert E. Kinhead (*Metal Progress*, 1934, 25, (1), 19-24).—Concentrated stresses, which may in service lead to excessive local stressing and consequent failure, may be due to alterations of contour, to local discontinuities or to the thermal effects of the welding process. Methods of avoiding or relieving such concentrations of stress are considered.—P. M. C. R.

**Do You Design or Just "Make" Your Welded Joints?** R. Kraus (*Machinery* (N.Y.), 1933, 40, 150-155).—Types of welds commonly used are discussed critically, and recommendations are given for the methods of making butt joints in plates of various thickness. Formulæ are given for calculating the stresses in different types of welds. Tables of permissible stresses in ferrous welds are included.—J. C. C.

**The Training of Metallic Arc Welding Students.** R. C. Stockton (*Welding Ind.*, 1933, 1, 240).—A classification is made of those requiring instruction in arc-welding and the suggested variations in the syllabus of an ideal welding course are outlined.—H. W. G. H.

**An Engineering Appraisal of the Welding Processes.** Robert E. Kinhead (*Metal Progress*, 1933, 24, (6), 15-18).—A review of the principal welding methods, the basis of comparison being the desirability of minimum divergence in composition and structure between base metal and the material of the weld.—P. M. C. R.

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## XXI.—INDUSTRIAL USES AND APPLICATIONS

(Continued from pp. 155-156.)

**Tentative Specifications for Aluminium Sheet and Plate (B 25-33 T).** — (*Amer. Soc. Test. Mat. Tentative Standards, 1933, 199-203; and Proc. Amer. Soc. Test. Mat., 1933, 33, (I), 605-609.*)—Cover aluminium sheet and plate. Commercial flat sheet shall be supplied on orders for sheet, except where coiled or strip sheet is specifically ordered. The minimum requirements for both sheet and plate are 99% aluminium as determined by chemical analysis. The specifications set forth the requirements as to samples; tensile requirements for the specified tempers and thickness; bend tests; test-specimens; permissible variations in thickness; workmanship and finish; inspection and rejection. —S. G.

**Tentative Specifications for Aluminium-Base Alloy Die-Castings (B 85-33 T).** — (*Amer. Soc. Test. Mat. Tentative Standards, 1933, 254-256; and Proc. Amer. Soc. Test. Mat., 1933, 33, (I), 641-643.*)—Seven alloys are specified, designated Nos. IV-IX, inclusive, and XII, the requirements as to chemical composition of which are given in a table.—S. G.

**Tentative Specifications for Aluminium-Base Alloy Sand-Castings (B 26-33 T).** — (*Amer. Soc. Test. Mat. Tentative Standards, 1933, 189-193; and Proc. Amer. Soc. Test. Mat., 1933, 33, (I), 595-599.*)—Cover commercial aluminium-base alloy sand-castings having a sp. gr. of 3 or less. Nine alloys are specified and are designated Alloys B, C, E, F, G, GG, H, J, and K. The alloys may be made by any approved method. Tables set forth the requirements as to chemical composition and tensile properties for the different grades, and the requirements regarding sampling, test-specimens, number of tests, inspection, and rejection are given. Explanatory notes give the approx. sp. gr. of each grade of alloy with some particulars of their particular properties and uses.—S. G.

**Tentative Specifications for Aluminium-Base Sand-Casting Alloys in Ingot Form (B 58-33 T).** — (*Amer. Soc. Test. Mat. Tentative Standards, 1933, 186-188; and Proc. Amer. Soc. Test. Mat., 1933, 33, (I), 592-594.*)—Cover commercial aluminium-base sand-casting alloys in ingot form for remelting. The sp. gr. of these alloys does not exceed 3.0. Nine alloys are specified and are designated Alloys B, C, E, F, G, GG, H, J, and K. The alloys may be made by any approved process. A table sets forth the requirements as to chemical composition for the different grades, and details regarding quality, sampling, inspection, and rejection are given.—S. G.

**British Standard Specification for "Y" Alloy Forgings for General Engineering Purposes.** — (*Brit. Standards Inst. No. 533, 1934, 1-10.*)—The aluminium used is to be in accordance with British Standard Specification No. 360. The forgings are required to contain copper 3.5-4.5, nickel 1.8-2.3, magnesium 1.2-1.7, with iron and silicon not greater than 0.5% and 0.6% respectively. Mechanical tests are specified, varying according to the character and size of the forging. Test-samples are heat-treated simultaneously with the forgings represented, and are cut so that the grain runs longitudinally. In large forgings a test-sample may be forged integral with the forging represented, or may be separate as arranged. A Brinell hardness test is made on the tensile test-sample and on at least 10% of the forgings. Other clauses deal with dimensions, manufacture, and test-samples. An appendix gives the required heat-treatment of quenching from 505° to 520° C. in cold water, boiling water, or oil, and allowing to age fully in at least 5 days or heating for 1 hr. at 100° C. and cooling in air.—R. G.

**British Standard Specification for Light Alloy Forgings for General Engineering Purposes.** — (*Brit. Standards Inst. No. 532, 1934, 1-8.*)—The specification is for alloys of sp. gr. not greater than 2.85, and covers the alloy generally known

as Duralumin. The aluminium used is to be in accordance with British Standard Specification No. 360. The forgings shall have the composition copper 3·5–4·5, manganese 0·4–0·7, magnesium 0·4–0·7, with iron not more than 0·75%. The number of test-samples is dependent on the weight of the forging, and when heat-treatment is applied, one forging for test is taken from each batch. Mechanical tests are specified, and the minimum values required decrease with increase in diameter of test-sample (tensile strength 25–18 tons/in.<sup>2</sup>). A Brinell hardness number of 100–90 is specified. Other clauses deal with dimensions, defects, test-pieces, and testing facilities. An appendix gives the required heat-treatment of quenching from 480°–490° C. and allowing to age for about 4 days.—R. G.

**Tentative Specifications for Aluminium Alloy (Duralumin) Sheet and Plate (Aluminium–Copper–Magnesium–Manganese) (B 78–33 T).** — (*Amer. Soc. Test. Mat. Tentative Standards*, 1933, 204–207; and *Proc. Amer. Soc. Test. Mat.*, 1933, 33, (I), 610–613).—Requirements are set forth as to manufacture, chemical analysis, tensile properties, bend tests, test-specimens, permissible variations in thickness, workmanship and finish, and inspection. The sheet or plate shall conform to the following chemical composition: copper 3·5–4·5, magnesium 0·2–0·75, manganese 0·4–1·0, aluminium (minimum) 92%. —S. G.

**Tentative Specifications for Aluminium Alloy (Duralumin) Bars, Rods, and Shapes (Aluminium–Copper–Magnesium–Manganese) (B 89–33 T).** — (*Amer. Soc. Test. Mat. Tentative Standards*, 1933, 194–198; and *Proc. Amer. Soc. Test. Mat.*, 1933, 33, (I), 600–604).—The alloy shall conform to the following as to chemical composition: aluminium (min.) 92·0, copper 3·5–4·5, magnesium 0·2–0·75, manganese 0·4–1·0%. Details are given regarding chemical analysis; mechanical properties of bars, rods, and shapes; bend test; test-specimens; dimensions and permissible variations; inspection and rejection.—S. G.

**Tentative Specifications for Aluminium–Manganese Alloy Sheet and Plate (B 79–33 T).** — (*Amer. Soc. Test. Mat. Tentative Standards*, 1933, 208–212; and *Proc. Amer. Soc. Test. Mat.*, 1933, 33, (I), 614–619).—Commercial flat sheet shall be supplied on orders for sheet except where coiled or strip sheet is specifically ordered. The requirements as to chemical composition are: manganese 1·0–1·5, copper (max.) 0·2, aluminium (min.) 97·0%, and those for samples, tensile requirements for the various tempers, bend tests, test-specimens, permissible variations in thickness, workmanship and finish, and inspection and rejection are set forth.—S. G.

**The Future Trend in Forged and Cast Light Alloys.** W. C. Devereux (*Metallurgia*, 1934, 9, 101–102).—A review of the high-quality aluminium alloys that obtain their maximum physical properties by heat-treatment both in the wrought and cast conditions indicates that there has been recently an intense growth in their application to many new industries where saving in weight is essential. Such industries are transport, shipbuilding, and textile, and the manufacture of box, printing, and packing machines. Magnesium alloys also continue to have useful applications principally in transport work. The keynote of the future development of all such light alloys is their quality and reliability.—J. W. D.

**Developments and Applications of Aluminium and Its Alloys.** Anon. (*Metallurgia*, 1934, 9, 102–104).—The application of aluminium alloys to the transport, rayon, and rubber industries and in the manufacture of dairy equipment, beer barrels, various kinds of trays for the confectionery trade, bottles for essential oils, perfumes, chemicals, and outdoor signs of coloured designs is reviewed and the properties which renders those alloys suitable for such purposes are discussed. Consideration is also given to the heat-treated alloys and to the corrosion-resisting alloys, and the physical properties of various alloys of both types are dealt with.—J. W. D.



**The Use of Aluminium in Industry.** N. D. Pullen (*Proc. Inst. Chem.*, 1934, (1), 42-43).—A lecture.—E. S. H.

**Properties, Production, and Application of Aluminium.** W. Tyson (*Aluminium Broadcast*, 1933, 4, (18), 2-4).—Abstract of a lecture to the Wolverhampton and District Engineering Society.—J. C. C.

**Alleged Danger of Aluminium Cooking Utensils.** Hermann Eppinger (*Dissertation: Univ. Tübingen*, 1931, 35 pp.).—The amount of aluminium absorbed from a normal diet is about 30 mg. per day; this is increased to a maximum of 50 mg. per day by the use of aluminium cooking utensils, and experiments on animals have shown that much greater quantities of aluminium can be absorbed without fear of ill-effects. Of all the various metals used in the manufacture of cooking utensils, aluminium contaminates the food least; even with acid foods there is no metallic flavour introduced, nor is the natural flavour deleteriously affected by cooking or storage in aluminium utensils.

—A. R. P.

**A Select, Annotated Bibliography on the Hygienic Aspects of Aluminium and Aluminium Utensils.** Edward R. Weidlein and George D. Beal (*Mellon Inst. Indust. Res., Bibliog Series, Bull. No. 3*, 1933, 80 pp.).—A critical review of the evidence which has been published on the toxicity of aluminium compounds and on the alleged danger of using aluminium cooking utensils leads to the conclusion that aluminium vessels are absolutely safe, and that their use does not cause disease or poisoning of any kind. A select, annotated bibliography on the occurrence of aluminium in foods and tissues, the action of foods, biological materials, and chemicals on aluminium, the physiological and pharmacological aspects of aluminium and medical considerations with regard to aluminium, is appended.—A. R. P.

**[Aluminium] Painting in Food Factories.** Albert E. Robinson (*Food*, 1933, 3, 18-20; *C. Abs.*, 1934, 28, 217).—A brief discussion of the benefit of painting, more particularly in the case of aluminium paints.—S. G.

**Light Alloys and the Transport of Liquid in Tanks.** A. Dumas and R. Kauffmann (*Rev. Aluminium*, 1933, 10, 2017-2026; and (abstract) *Allègement dans les Transports*, 1933, 2, 102-103).—Since aluminium resists the action of acids and hydrogen peroxide, which attack steel, it is used extensively in the manufacture of tanks and cisterns for the transport of alimentary liquids, such as beer and milk. For most purposes, aluminium alloys containing 2% of manganese are used, joins being made by autogenous welding, but tanks for acids are made of aluminium guaranteed 99.5%. Owing to its lower strength compared with steel, certain precautions regarding shape and dimensions are taken, but the resulting tanks are then very robust. A number of examples of tanks and lorries made of aluminium and aluminium alloys are given. Although the initial cost of a light alloy tank is about double that of a similar steel tank, the difference in price is recouped by the saving in dead weight transport in 6-8 months.—J. H. W.

**Aluminium for Reflectors.** A. B. Oday and A. F. Dickerson, and J. D. Edwards (*Iron Age*, 1934, 133, (5), 25-26; and *Met. Ind. (Lond.)*, 1934, 44, 324-325).—Based on 2 papers read before the (U.S.) Illuminating Engineering Society. By anodically coating aluminium in electrolytes of patented composition (Alumilite process) the reflectivity of the metal is raised to 85%. The surface is sealed so as to make it impervious to tarnishing in industrial atmospheres, resistant to weather, and readily cleanable by washing in soap and water.—J. H. W.

**Coloured Aluminium.** Anon. (*Machinist (Eur. Edn.)*, 1934, 78, 50E).—Describes the Alumilite process for permanently dyeing aluminium. See preceding abstract.—J. H. W.

**A Novel Method of Heat-Insulation.** Edwin Gunn (*Architect*, 1934, 137, 124).—A note on the use of aluminium foil reinforced with asbestos as a heat insulator in roofing.—P. M. C. R.

**Aldrey Cables in Service.** Maurice Thomas (*Bull. Assoc. Suisse Élect.*, 1934, 25, 99–104).—Statistics show the length and tonnage of Aldrey high-tension conductors and telephone wires in use in Switzerland and other European countries in Dec. 1932. High-tension cables in Switzerland are classified according to material—copper, bronze, aluminium, aluminium + steel, or Aldrey, the use of the last-named steadily increasing. The alloy does not sag, and if reinforced with annealed aluminium tape does not snap at joints; exposure to low temperature increases its strength, moderate heating (to 100° C. for 180 days) causes relatively little weakening, the danger of fusion is said to be negligible and the wind-resistance good. Working conditions for Aldrey cables in Europe are tabulated. A bibliography is given.—P. M. C. R.

**Aluminium Enters Bridge Construction.** Charles M. Reppert (*Eng. News-Record*, 1933, 111, 611–615).—The steel and timber floor of Smithfield St. Bridge, Pittsburgh, has been replaced by one made from aluminium alloy ribbed slabs supported on aluminium alloy framing, assembled with hot-driven steel rivets, with a resulting saving in weight of 751.4 tons. All floor members were designed on the basis of using "17 ST" alloy, but when "27 ST" alloy subsequently became available this was used without change of design in view of superior physical and corrosion-resisting properties. For the hand rail, tubing of "4 SH" alloy and rolled shapes of "53 ST" alloy were chosen on account of their high corrosion-resistance.—J. C. C.

**Aluminium and Its Alloys in Transport Vehicles.** J. Krapf (*Schweiz. Tech. Zeit.*, 1933, (15/16), 214–220).—Typical examples are described.—W. A. C. N.

**Problems of the Hauler and Carrier.** Anon. (*Commercial Motor*, 1933, 57, 94, 122; *Aluminium Broadcast*, 1933, 4, (16), 1–6).—Details are given of weight reductions possible by the use of aluminium alloy for the bodies of motor vehicles, together with estimates of the resulting savings through increased carrying capacity and reduced operating costs.—J. C. C.

**Use of Aluminium and Aluminium Alloys in 1934 Automobile Designs.** W. Tyson (*Aluminium Broadcast*, 1934, 4, (22), 1–11).—Details, supplied by the manufacturers, are tabulated showing the materials used in the construction of the principal components of 30 British makes of cars.—J. C. C.

**Aluminium in Boat and Ship Building.** G. W. Lacey (*Shipbuilding and Shipping Record*, 1934, 43, 66–67; *Aluminium Broadcast*, 1934, 4, (22), 1–4).—A general review.—J. C. C.

**Aluminium in Ship Construction.** P. Urech (*Schweiz. Tech. Zeit.*, 1933, (15/16), 230–232).—A description of the design, construction, and materials of construction—mainly aluminium alloys—of the motor-boat "Mythen." The alloys principally used were those containing magnesium and manganese, and also Silumin.—W. A. C. N.

**Duralumin in Modern Furniture.** V. Cheilly (*Cuivre et Laiton*, 1933, 6, 419–420).—W. A. C. N.

**Progress in the Industrial Application of Copper and Its Alloys.** J. W. Donaldson (*Metallurgia*, 1934, 9, 111–113).—Recent developments in the refining and purification of copper are discussed, the welding and brazing of copper are described, and new and extended industrial applications of the metal are dealt with. Consideration is also given to the increasing importance in many industries of the copper-nickel alloys, aluminium-brasses and bronzes, and the high-duty copper alloys, and to recent developments of special copper alloys with beryllium or phosphorus for industrial purposes.—J. W. D.

**Heat Experiments with Water Pipes of Iron and Copper.** St. Zeissl (*Z. Metallkunde*, 1933, 25, 266–267).—Comparative tests on the heat absorption of the water in tubes of galvanized iron (27 × 19 mm. diam.) and copper

(23 × 20 mm. diam.) as used in domestic installations, have shown that water in copper pipes does not become warmer than that in iron pipes owing to the higher heat radiation of the smooth and bright copper tubes.—M. H.

**Tentative Specifications for Magnesium Ingot and Stick for Remelting (B 92-33 T).** — (*Amer. Soc. Test. Mat. Tentative Standards*, 1933, 232-233; and *Proc. Amer. Soc. Test. Mat.*, 1933, 33, (I), 636-637).—Cover magnesium ingot and stick in one grade containing not less than 99.8% magnesium. Requirements are given regarding size and shape and approximate weight of ingot and stick; manufacture; chemical composition; claims, samples for umpire analysis and settlement of claims.—S. G.

**Tentative Standards for White Metal for Friction Bearings and Surfaces. New Outline for DIN 1703.** German Committee for the Standardization of Non-Ferrous Metals (*Z. Metallkunde*, 1933, 25, 292).—The composition (with admissible deviations and impurities), density, and uses of tin- and lead-base alloys containing copper and antimony are given.—M. H.

**The Presence of Tin in Food Products.** S. Back (*Food Manufacture*, 1933, 8, 381-384).—A review of published work, containing 40 references to the literature, on the sources and determination of tin in foodstuffs, and the pharmacological properties of tin compounds. It is shown that tin is a normal constituent of the bodies of men and animals, and that no harm results from the consumption of the minute amounts of tin found in food.—E. S. H.

**Tin in the Telephone Industry.** Anon. (*Tin*, 1933, December, 4-5).—The use of tin in the telephone industry for cable sheathing, as plumber's metal and solder, and for the prevention of corrosion is briefly discussed.—J. H. W.

**Furniture Sprayed with Metal.** Anon. (*Decorator*, 1933, 32, 60).—Bedroom furniture, coated with tin by spraying, is now on the market.—E. S. H.

**Tungsten Carbide Prolongs the Life of Machine Parts.** Anon. (*Machinery* (N.Y.), 1933, 40, 106; and (abstract) *Machinery* (Lond.), 1933, 43, 67).—Examples are described of the use of tungsten carbide for constructing parts subject to excessive wear, such as guide blocks, the stems and seats of hydraulic presses, nozzles delivering abrasives, dies for coating welding rods, and the work-blades of centreless grinders.—J. C. C.

†**New Patents in the Field of Sintered Hard Metals.** Karl Becker (*Metallwirtschaft*, 1933, 12, 673-674).—A review of patents published since B.'s last article (see *J. Inst. Metals*, 1933, 53, 679) dealing with sintered hard metal alloys with a base of tungsten or other carbide.—v. G.

†**Tungsten in World Economics.** Werner Einecke (*Dissertation: Univ. Hamburg*, 1930, 1-74).—A review of the production, uses, and prices of tungsten products.—A. R. P.

**Zinc in the Automotive Field.** W. M. Peirce (*Met. Ind.* (Lond.), 1933, 43, 465-466; and *Metal Stampings*, 1933, 6, 264).—Abstracts of a paper read before the Metal Congress, Detroit, U.S.A. The average motor-car of to-day contains 25-30 lb. of zinc, the use of which depends on low material and manufacturing costs and satisfactory performance. Rolled zinc and zinc alloys and zinc die-castings have many applications in the automobile industry, and these applications are described. The use of zinc die-castings in petrol pumps and for bushing journal bearings, and the advantages of zinc die-castings in general over sheet-metal stampings outside the automobile industry are discussed.—J. H. W.

**Matrix Alloy Reduces Tool and Die Costs.** J. R. Weaver (*Machinery* (N.Y.), 1933, 40, 129-132).—Matrix alloy contains bismuth, lead, tin, and antimony, has a tensile strength of 13,000 lb./in.<sup>2</sup>, a Brinell hardness of 19, and melts at 248° F. (120° C.). Accurate machining operations can often be dispensed with by using it to hold members of a tool or die in position. Examples are given of its use for holding the individual punches in the shoe



of a multiple press tool, for making stripper plates, and for locating bushings in drilling jigs. Methods of ensuring a firm anchorage between steel and matrix alloy are described.—J. C. C.

**Use of Alloys in the Sugar Factory.** Edwin A. Rogers (*Rep. Assoc. Hawaiian Sugar Tech. 12th Ann. Meeting, 1933*, 153–155; *C. Abs.*, 1934, 28, 359).—Attention is directed to the possible uses in the sugar factory of special steels, hard-surface metals, and non-ferrous materials for various purposes, and the experiences of 3 factories with such materials are described.—S. G.

**Structure and Fitting of Valve Seats for Motor Engines.** J. C. Fritz (*Automobiltech. Z.*, 1934, 37, (1), 12–14).—Excessive wear on Monel metal, brass, or steel valve seats may be avoided by inserts of cast iron, nickel, &c. A facing of Stellite or some similar hard alloy is usually applied to the insert. Cracks caused by overheating must be repaired by welding or soldering: F. prefers the latter process, especially by the Gussolit method. Examples of repairs and of new construction are illustrated.—P. M. C. R.

†**A. Figure of Merit.** W. Rosenhain (*Metallurgist* (Suppt. to *Engineer*), 1933, 9, 79–80).—A discussion of the engineer's problem of the choice of materials. Consideration of the different properties of metals in relation to their use shows that it is difficult to arrive at a single figure of merit for any material, and the principle of minimum values is suggested as being a safe one. The engineer would lay down for himself a minimum value for all the more important properties in a given class of material, to govern acceptance, but these should be subject to revision in special cases.—R. G.

**Tentative Standards for Non-Ferrous Metals of the American Society for Testing Materials.**—I. Paul Melchior (*Z. Metallkunde*, 1933, 25, 289–290).—Tentative specifications are given for ferro-tungsten, ferro-molybdenum, refined copper; stranded copper cables; sand castings of lead-tin-bronze and 20 copper-rich tin-lead-zinc-copper alloys; seamless copper tubes for oil; copper water pipes; rods and profiles of Duralumin. Some of them are compared with German standards.—M. H.

**On the Heat Consumption of Cooking Utensils.** H. J. Karmaus (*Illus. Z. Blechindustrie*, 1934, 63, (1), 13–15).—A comparative study, based on the work of Vielhaber (*Sprechsaal*, 1933, 66, (46),; and *Emaillwaren-Ind.*, 1928, 62–63) and Schultheiss (*Kölnische Z.*, 1928, (29)), of the heating efficiencies of cooking utensils of various materials and finishes. Materials include cast iron, sheet iron, and steel, stainless steel, aluminium, copper and porcelain, and among surface finishes are enamels of different colours, oxide layers, tinning, nickel plating, polishing, and grinding with emery. Enamelling is preferred as combining even heat distribution with high efficiency, while avoiding contamination or discoloration of food.—P. M. C. R.

## XXII.—MISCELLANEOUS

(Continued from pp. 52–53.)

†**The German Aluminium Industry.** Georg Günther (*Dissertation: Univ. Leipzig*, 1931, 1–78).—An historical survey of the growth and development of the German aluminium industry from raw material to finished product, with especial reference to the economics of the industry.—A. R. P.

**Steam Turbine Development Presents Problems in Design and Metallurgy.** C. B. Campbell (*Power Plant Eng.*, 1934, 38, 94–97).—Some modern developments in steam turbine practice are reviewed. Factors influencing blade erosion are analyzed. C. recommends stainless-steel blading carrying shield strips of No. 6 Stellite, attached by silver soldering.—P. M. C. R.

**Copper and Its Alloys in Horology.** V. Briard (*Cuivre et Laiton*, 1933, 6, 591–593).—A short historical account of the development of clockmaking,

particularly with regard to the gradual adoption of copper alloys for various parts owing to their resistance to wear. In addition, these alloys have been used extensively for ornamentation on chronometers and timekeepers of all kinds.—W. A. C. N.

**\*On Brass-Founder's Ague.** H. Safir (*Veröffentlichungen aus dem Gebiet der Medizinalverwaltung*, 1932, 38, 599-627; and (abstract) *Metallwirtschaft*, 1933, 12, 725).—The causes of this industrial disease have been investigated in a Berlin hospital; it is produced by breathing metal vapours and oxide dust. The symptoms are described; the treatment includes inducing copious perspiration and an egg diet. Prevention of the fever is obtained by adequate ventilation in the works.—v. G.

**Gold Wares of 14 Carat.** S. W. Smith (*Sixty-Third Rep. Royal Mint (Lond.)*, 1932, 55).—By the "Gold Wares (Standard of Fineness) Order, 1932," issued as an Order in Council, 14-carat gold (0.585) was adopted as a legal standard and the existing standards of 12 and 15 carat were abolished. The exact equivalent of 14 carat is 583.3 parts per thousand, but by agreement at an International Congress in London, 1930, the standard of 585 parts per thousand was adopted.—J. H. W.

**The Sydney Mint. Its Foundation and Functions.** Clement Blazey (*Met. Ind. (Lond.)*, 1934, 44, 107-108, and 110).—A brief description is given of the work done by the Sydney Mint from 1855 until it was closed down in 1926.

—J. H. W.

**Zinc and Its Relation to General and Industrial Health.** Cecil K. Drinker and Lawrence T. Fairhall (*Public Health Rep.*, 1933, 48, 955-961; *Chem. Zentr.*, 1933, 104, II, 3896).—The permissible limit of 5 mg./l. of zinc in water is much below the danger limit. Foods or drinks (other than drinking water) should not be stored in zinc or zinc-coated vessels, since any acid present is liable to attack the zinc, and thus cause the food to become contaminated. Zinc ague is stated not to be due to breathing of zinc fumes, but to the presence of other poisonous materials in the fumes.—A. R. P.

**Moulding and Casting Technique in the Pre-Christian Era.** E. Piwowarsky (*Technikgeschichte*, 1933, 22, 25-32; and *Mitt. Giesserei-Inst. Tech. Hochschule, Aachen*, 1934, 3).—The composition of some ancient bronzes is given, and examples of ancient Greek and Chinese bronze and lead castings and the moulds used for making them are illustrated and discussed.—A. R. P.

**Powder Metallurgy, as Illustrated by Tungsten.** W. P. Sykes (*Metal Progress*, 1934, 35, (3), 24-29).—The high melting point of certain metals, whilst rendering them especially suitable for use under severe temperature conditions, also imposes limitations on the method of working. The preparation of tungsten powder from the trioxide, and the sintering and subsequent working of the powder, are fully described. Conditions governing grain-size in the finished product are discussed. The working of Elkonite (tungsten-copper), various alloys intended for die-making, tungsten carbide, thorium, and certain ferrous alloys is briefly considered, and some further applications of the process are indicated.—P. M. C. R.

**Impressions of a Consultant Engineer on Tours of Continental Ferrous and Non-Ferrous Tube Works.** Gilbert Evans (*Metallurgia*, 1934, 9, 70-72).—The technique in various non-ferrous tube works in France, Norway, Sweden, and Denmark is briefly described with special reference to methods of drawing, piercing, and heat-treatment, and to the class of materials produced. It is stated that in general the lay-out and the working routine are founded on British methods, which have been improved and extended. The main mechanical productive plants are also of British manufacture.—J. W. D.

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### XXIV.—BOOK REVIEWS

(Continued from pp. 158-160.)

**Les Méthodes d'étude des Alliages métalliques.** Par Léon Guillet. Deuxième édition. Roy. 8vo. Pp. xv + 859, with 998 illustrations. 1933. Paris: Dunod. (Relié, 203 francs; broché, 192 francs.)

The title of this book is rather misleading, since it contains not only a description of practical methods of investigating alloys, but also much of the theory of physical metallurgy and metallography, and numerous results of tests on metals and alloys, and physical constants, &c. The volume is described as a new treatise emphasizing modern work, and not merely as a second edition of the author's book of 1923. The subjects dealt with include thermal analysis, "coulabilité" (a term used to describe not merely fluidity, but also the power of filling a mould), dilatometric methods, electrical resistance, thermo-electricity, electrolytic solution potentials, magnetism, radiology and X-ray crystal analysis, metallography and macrography, heats of formation, chemical analysis, corrosion tests, and tensile, hardness, impact, fatigue, and other mechanical tests.

The quality of the book is very variable. It is clearly written, and the merits of the earlier book (see *J. Inst. Metals*, 1923, 29, 844) are retained except where the subject-matter has become out of date. As regards more modern work, the chief value of the book to the English reader lies in the descriptions of recent French apparatus, particularly for mechanical testing, many machines being described in great detail. For work outside France, however, the book is much less satisfactory, and is often out of touch with modern methods, whilst the lists of references given at the end of several chapters are not representative of the best metallurgical work of the last ten years. The book suffers from a lack of the power of critical selection, and in some cases the effect of new work on what has been written previously has not been considered sufficiently carefully. This is particularly noticeable in the case of equilibrium diagrams, some old diagrams being reproduced which have been proved incorrect for many years, whilst minor inconsistencies between different parts of the book may cause difficulty to the elementary reader.

The publication methods call for criticism. There are a number of discrepancies between the text and the figures, and an unduly large number of names are mis-spelt. The references are also given in an exasperating manner, with an entire lack of uniformity. Thus references to papers in the *Journal* of the Institute of Metals appear in at least six forms, and in many cases the numbers of volumes and pages are omitted.

From its very size the book includes a great deal of useful information, but, as regards modern work, there is need for more critical care both in selection of subject, and method of presentation and publication.—W. HUME-ROTHERY.

**Aluminium; Its Manufacture, Properties, and Uses.** By H. Sainte-Claire Deville. Translated from the French by Robert J. Anderson. Med. 8vo. Pp. xv + 204, with 13 illustrations. 1933. Cleveland, O.: Sherwood Press, Box 2617, Lakewood Branch. (\$5.00, post free.)

Although this is by no means a text-book to which the research worker of the moment will wish or need to refer, it is of great historical interest, as it records the experimental results and



the opinions of one of the pioneers in the manufacture and application of aluminium, whilst its value to those concerned with patents relating to aluminium and its alloys may be even greater.

The manufacture of the metal by reduction of its purified salts by metallic sodium and the production of the necessary sodium is described in such detail as the knowledge of the time allowed. The physical and chemical properties of the metal as recorded by Deville are correct according to modern knowledge, with a few exceptions, and in these it would appear that it is only the general expansion of chemical knowledge during the last eighty years which prevents our making deductions similar to those of Deville. The excellent properties of "aluminium-bronze," the difficulties of soldering aluminium and its alloys, are clearly anticipated, whilst the author forecast with uncanny accuracy the probable applications of the metal and its alloys, and, it should particularly be noted, was fully aware of the effect of purity on the physical and chemical behaviour of both the pure metal and its alloys. He particularly stresses the probability that certain results may be erroneous due to the relative impurity of the metal used in the tests.

The translator is to be congratulated on his work, although the universal spelling of aluminium as "aluminum" may irritate British readers.—R. B. DEELEY.

**Gmelins Handbuch der anorganischen Chemie.** Achte völlig neu bearbeitete Auflage. Herausgegeben von der Deutschen Chemischen Gesellschaft. Bearbeitet von R. J. Meyer. System Nummer 59: **Eisen**, Teil A.—Lieferung 5. Roy. 8vo. Pp. 847-1166, with numerous illustrations. 1933. Berlin: Verlag Chemie G.m.b.H. (R.M. 50; subscription price, R.M. 43.50.)

The present section completes the chapters on the technical production of iron, which was commenced in the third "Lieferung," p. 423, so that the presentation of the metallurgy of iron, completed in this "Lieferung," is the most complete that has yet appeared. The opening section (112 pages) deals with the general physico-chemical basis of the processes for the production of wrought iron; the treatment is both wide and thorough. Following on this comes a section on the founding of iron and steel (67 pages); the processes of melting iron and steel in the various types of furnace, for the purposes of iron-founding, are described and discussed in detail, conditions and materials used in the processes being critically considered. The third section treats alloys of iron (59 pages); here are considered iron alloys with silicon, manganese, aluminium, beryllium, boron, cerium, chromium, cobalt, molybdenum, nickel, phosphorus, tantalum, titanium, uranium, vanadium, tungsten, and zirconium. As well as the binary alloys enumerated, the same alloys with small amounts of a third or fourth metal added are also considered. Numerous phase diagrams illustrate this section. An appendix to the earlier published section on the production of technical iron completes the volume.

The work gives a most satisfactory and exhaustive account of the subjects considered, it is most efficiently and thoroughly compiled, and will serve for a very long time as the standard work on the subject. It is a book which can be recommended confidently, and which must be accessible to all chemists and metallurgists.—JAMES F. SPENCER.

**Hilfsbuch für Einkauf und Abnahme metallischer Werkstoffe.** Von Ernst Pohl. Demy 8vo. Pp. viii + 143, with 88 illustrations. 1933. Berlin: VDI-Verlag G.m.b.H. (R.M. 8; VDI-Members, R.M. 7.20.)

This book is intended for the use of those in works that are engaged in the fabrication of metallic articles and have no expert or laboratory available. The author has endeavoured, with a measure of success, to compress into a small space the essential details of simple testing methods, and the important data of the essential properties of commercial metals and alloys, by means of which incoming raw materials and outgoing finished products may be proved. A very considerable portion is devoted to iron and steel. Among the non-ferrous materials which come under review, however, are the following metals and their alloys—copper, aluminium, magnesium, lead, tin, zinc, and nickel. The general treatment in each case follows a definite sequence—use, chemical properties, mechanical properties, soldering and welding, appearance of faults, testing (including tolerances, surface quality, hardness, tests to destruction, bending, chemical analysis, and metallographic examination). In cases where the material is normally subjected to special processes such as drawing, stamping, conductivity, &c., these are specifically dealt with under the appropriate heads. It must be recognized, of course, that the majority of the alloys mentioned are those that are prevalent in German practice and in some instances, known by characteristic designations. Especial attention is given to welding and the examination of welds, as it is recognized that modern construction is demanding more and more of this type of work.

The value of the book as a work of reference is enhanced by the free quotation of larger treatises and of articles in footnotes on almost every page. The tables, of which there are a large number, and the illustrations, are clear and correspond reasonably with the textual matter.

It may safely be said that this small volume is a very useful compendium of information, and should be especially valuable in a small foundry or engineering workshop.

—W. A. C. NEWMAN.

**Tin-Plate Decoration and the Lacquering of Food Containers, Illustrated by Micro-Photography.** By A. Ll. Matthison. Demy 8vo. Pp. 134, with 61 illustrations. 1931. Birmingham: The Author, Adderley Works, Bordesley Green. (12s. 6d.)

This book is already well known as a useful work on a subject about which relatively little has been written. Coming from an author who can claim a very extensive practical knowledge and experience of lacquers for tinplate, it is essentially a practical book, written from the industrial point of view, and as such should be read by all who are engaged in the tinplate, canning, and lacquer industries. In scope the book covers, among other items, the preparation and cleaning of tinplate prior to lacquering or decoration, the technique of lacquering and printing, a detailed practical description of ovens, and a discussion of the causes of defects. A considerable section is devoted to food containers, including a comparison of British and American methods. A valuable feature is the large number of practical hints on matters of difficulty, which the author is able to give from his own experience.

In places Mr. Matthison is perhaps a little hard on the tinplate manufacturer, but one realizes that the tinplate industry often blames the lacquer manufacturer in turn. Many defects of lacquered tinplate cannot be traced either to the tinplate or the lacquer individually, but to the bond between the two. The nature of this bond can be understood completely only by close collaboration among those experienced in the two products. One has no doubt that the author would be among the first to encourage such collaboration.

The title of the book is somewhat misleading, as the amount of information given on tinplate printing is very meagre. It is also disappointing to find that no information is given on the composition and physical and chemical properties of lacquers. On the whole, one is left with a sense of the need for fundamental research on the lacquer problem and for wider dissemination of the scientific aspect of the work which has already been done.—E. S. HEDGES.

**Untersuchungsmethoden für die Vernickelungs- und Verchromungspraxis.**

Von H. Wagner. Med. 8vo. Pp. viii + 61, with 8 illustrations. 1933.

Leipzig: Max Jänecke. (R.M. 1.80.)

This is essentially a practical handbook of an elementary nature. Nearly one half of the booklet is devoted to describing elementary principles, such as filtering and washing precipitates, weighing, measuring vessels, titrations, reagents used, &c. It is best either to discuss such matters adequately or to omit them. The remainder is concerned mainly with analytical methods for the control of the bath and appears to contain nothing new.—E. S. HEDGES.

**A Textbook of Inorganic Chemistry.** By F. Ephraim. English edition by P. C. L. Thorne. Second edition revised and enlarged. Roy. 8vo. Pp. xii + 873, with 85 illustrations. 1934. London and Edinburgh: Gurney and Jackson. (28s. net.)

This new and very welcome second edition of the translation of Ephraim's *Inorganic Chemistry* appears after a lapse of less than 8 years since the first translation appeared. The important advances of inorganic chemistry during that period have been incorporated into the text of the present edition. There is little change in the arrangement and method of treatment of the matter discussed, but the new matter which occurs in almost every chapter has enlarged the book by some 86 pages. The book in its present edition is just as desirable a volume as its predecessor. The remarks made in connection with the earlier edition are applicable to the present edition. The book is to be strongly recommended to all students of chemistry and to those who, while not serious students of the subject, desire a clear statement of the present position of inorganic chemistry.—JAMES F. SPENCER.

**The Directory of Shipowners, Shipbuilders, and Marine Engineers, 1934.** (32nd edition.) Demy 8vo. Pp. 812 + 75. 1934. London: The Directory Publishing Co., Ltd., 33 Tothill Street, S.W.1. (20s. net.)

This Directory forms a handy desk companion, and furnishes particulars of all the leading steamship companies, shipbuilders, ship-repairers, and marine engineering works throughout the world. It also gives the names of the directors and principal officials of the companies and, in the case of shipping concerns, details of the fleets. A supplementary section includes a list of societies, institutions, trade and labour federations, and a directory of consulting marine engineers and naval architects. At the end of the volume are exhaustive indexes covering some 25,000 entries.