

METALLURGICAL ABSTRACTS

(GENERAL AND NON-FERROUS)

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Part 2

L—PROPERTIES OF METALS

(Continued from pp. 1-3.)

*The Electrical Resistance of Aluminium at Low Temperatures. H. A. Boorse and H. Niewodniczański (*Proc. Roy. Soc.*, 1936, [A], 153, 463-475).—The electrical resistance of six polycrystalline aluminium wires was measured at 0° C. and at the temperatures of liquid nitrogen and liquid hydrogen; measurements at the temperature of liquid helium were made on four of the wires which were drawn from very pure aluminium (99.995% purity). The resistances of these four wires were found to be constant between 4.2° and 2.2° K. Reduced resistivities of these wires were calculated by the Matthiessen-Nernst formula and compared with values deduced from Grüneisen's expression. Satisfactory agreement was found for the values corresponding to the temperature of liquid nitrogen but not for those at liquid hydrogen temperatures.—J. S. G. T.

*On the Different Behaviour of Single Crystals of Aluminium of Different Purities Prepared from the Molten Metal and by Recrystallization. F. Gisen (*Z. Metallkunde*, 1935, 27, 256-261).—Single crystals of aluminium of 99.5, 99.8, 99.87, and 99.998% purity were prepared by maintaining the metal in a molten state at 800°-820° C. until all nuclei had disappeared and then cooling very slowly. The tensile properties of these crystals were compared with those of single crystals prepared from the same grades of aluminium by recrystallization after critical extension. Large single crystals of the purest grade were obtained by drawing 8 mm. rod to 4.5 mm., annealing at 250° C. for 15 hrs. to obtain a homogeneous fine-grained structure, stretching 0.5-1%, and then slowly heating from 430° to 480° C. over a period of 45 hrs. Load-reduction in cross-section curves for the various grades showed that single crystals of aluminium prepared by recrystallization have a well-defined critical shear strength which steadily decreases with decreasing purity to about 70 gm./mm.² for the pure metal; for single crystals of aluminium prepared from the melt this value is certainly less than 20 gm./mm.² for all grades from 99.5 to 100%. This difference is attributed to the more pronounced mosaic structure of crystals prepared by recrystallization, a theory which is confirmed by intensity measurements of the reflections obtained in rotating crystal X-ray photographs.—A. R. P.

*The Change of Resistance of Bismuth Single Crystals in a Magnetic Field at Low Temperatures. W. J. de Haas, J. W. Blom, and L. Schubnikow (*Physica*, 1935, 2, 907-914).—[In German.] Measurements of the change of resistance of bismuth single crystals in magnetic fields within the temperature range attainable with liquid helium show that the effect of the magnetic field at 4.22° K. is greater than that at 14.15° K. and almost the same as that at 1.35° K. The dependence of the resistance of a single crystal on the orientation of the binary crystallographic axes in relation to the lines of magnetic force is much more complicated in character at 1.35° and 4.22° K. than at 14.15° K.—J. S. G. T.

*Crystalline Properties and Magnetic Anisotropy of Distilled Bismuth. A. Goetz, O. Stierstadt, and A. B. Focke (*Z. Physik*, 1935, 98, 118-127).—Apparatus for distilling and condensing bismuth in a high vacuum is described.

* Denotes a paper describing the results of original research.

† Denotes a first-class critical review.

The condensate is found to consist of a microcrystalline film of thickness 0.5 to 0.1 mm., upon which a macrocrystalline deposit of similarly oriented crystallites, with their [111]-axes arranged approximately parallel to the direction of growth, is deposited. These crystals are characterized by an approximately equidistant stratification of thickness 0.5 μ . The magnetic anisotropy, R , *i.e.* the ratio of the magnetic susceptibilities measured normal to, and parallel to [111], is measured for single crystals prepared from the condensate. The effect of lead impurities, present in the bismuth at an atomic concentration N , on the value of R is found to be given by $R = R_0 + A \cdot N^\beta$, where β varies considerably with temperature and is > 0.5 and < 1 . Distillation does not appear to be a suitable process for purifying bismuth.

—J. S. G. T.

***X-Ray Investigation of the Thermal Expansion of Cadmium.** G. F. Kosolapow and A. K. Trapešnikow (*Z. Krist.*, 1935, 91, 410–423).—[In German.] The lattice constants (a and c) of cadmium have been determined for the temperature range 26°–189° C. The values at 26° C. agree well with those of Stenzel and Weerts and with those of Kožina and Rowinsky. The value of c/a increases with increase of temperature. Values of the coefficient of linear expansion respectively perpendicular (α_1) and parallel (α_{11}) to the hexagonal axis were found as follows within this temperature range: α_1 , 1.7 – 2.2×10^{-5} ; α_{11} , 4.8×10^{-5} . Values of the volumetric coefficient of expansion, β , calculated from these values are $\beta_{85^\circ} = 8.33 \times 10^{-5}$; $\beta_{85^\circ} = 8.75 \times 10^{-5}$, and $\beta_{107^\circ} = 9.25 \times 10^{-5}$. These values are in agreement with those found by Uffelmann by an optical method.—J. S. G. T.

†**Oxygen in Copper.** H. J. Miller (*Metal Treatment*, 1935, 1, 191–194, 201).—The relation between the oxygen and hydrogen contents of molten copper and the “set” and soundness of the ingots produced; the production of deoxidized and oxygen-free high-conductivity copper; the solubility and distribution of cuprous oxide in copper and its effect on softening temperature; tensile properties before and after drawing; impact and fatigue properties; and liability of the copper to “gassing” are dealt with in this review. A bibliography of 22 references is appended.—J. C. C.

***The Adsorption of Hydrogen and Deuterium on Copper at Low Pressures.** Ralph A. Beebe, George W. Low, Jr., Edwin Lincoln Wildner, and Seymore Goldwasser (*J. Amer. Chem. Soc.*, 1935, 57, 2527–2532).—At -78° C. the rate of adsorption of deuterium on copper is less than that of hydrogen, but at equilibrium equal amounts of the two isotopes are adsorbed. Between 0° and 125° C. the ratio H_2/D_2 adsorbed undergoes an inversion, hydrogen being more strongly adsorbed at the lower temperatures and less strongly adsorbed at the higher.—A. R. P.

***Permeability to Hydrogen of Copper, Iron, Nickel, Aluminium, and Some Alloys.** W. Baukloh and H. Kayser (*Z. Metallkunde*, 1935, 27, 281–285).—No hydrogen diffuses through drawn copper tubes or drawn aluminium tubes at temperatures almost up to the melting point, but diffusion occurs through iron, nickel, nickel-iron, and copper-nickel alloy tubes at temperatures above about 550° C., pure nickel being the most permeable metal. In the case of the alloy tubes the permeability increases with the nickel content and temperature and decreases with an increase in wall thickness. Nickel is impermeable to helium, argon, neon, and krypton.—A. R. P.

***Magnetism of Copper.** S. Ramachandra Rao (*Nature*, 1935, 136, 436).—The magnetic susceptibility of copper increases with the degree of comminution of the metal. A critical stage is reached at 0.8μ , below which diameter the susceptibility undergoes a rapid increase.—E. S. H.

Copper Data. — (*Copper Development Association Publ. No. 12*, 1935, 64 pp.).—Deals with the properties of copper (mechanical; physical; electrical; corrosion-resistance), treatment and working (refining; oxygen in

copper and deoxidized copper; additions of other elements; working and annealing; tinning; joining; machining), commercial grades and applications (grades and forms; semi-manufactured—sizes, tolerances of plate, strip, tube, &c.; engineering and industrial applications). An appendix gives a graph showing average metal prices for copper and certain other metals for the period 1924–1934, a list of British Standard Specifications relating to copper, and weight tables.—S. G.

Thermo-E.m.f., Peltier Heat, and Photo-E.m.f. in the Cell Copper-Cuprous Oxide-Copper. G. Mönch (*Physikal. Z.*, 1935, 36, 755–757).—Theoretical considerations relating to the calculation of values of the thermo-e.m.f., the Peltier effect, and the photo-e.m.f. in a circuit comprising two metal conductors, e.g. of copper, united by a semi-conductor, such as cuprous oxide, are discussed briefly.—J. S. G. T.

***Observations on the Rare Earths. XLVI.—The Atomic Weight of Gadolinium.** C. R. Naeser with B. S. Hopkins (*J. Amer. Chem. Soc.*, 1935, 57, 2183–2184).—The value found was 156.85 ± 0.011 .—L. A. O.

***Revision of the Atomic Weight of Germanium. I.—Analysis of Germanium Tetrabromide.** O. Hönigschmid and R. Schlee (*Z. anorg. Chem.*, 1935, 225, 81–89).—The value found was 72.59.—A. R. P.

***Mercury in Powder Form.** A. Galatzky (*Bull. Soc. chim. France*, 1935, [v], 2, 1801–1807).—Mercury can be obtained in the form of an active, light grey powder, which coalesces to droplets only on heating to 150° C. or on grinding in a mortar, by reduction of an aqueous suspension of mercurous oxide with hydrazine, hydroxylamine, or formaldehyde. The powder consists of minute spheres of the metal coated with a very thin film of mercurous oxide; owing to its large surface area evaporation is relatively rapid and a strong metallic smell may be observed even some distance away. Mercury powder amalgamates instantaneously with gold or tin.—A. R. P.

***The Formation of [Diatomic] Mercury Molecules.** F. L. Arnot and J. C. Milligan (*Proc. Roy. Soc.*, 1936, [A], 153, 359–378).—The existence of diatomic molecular ions of mercury has been established, for the first time, by magnetic analysis of ions produced in mercury vapour by electron impact. The mechanism of their production is discussed.—J. S. G. T.

***The Volume Magnetostriction Effect in Nickel and Magnetite.** M. Kornetzki (*Z. Physik*, 1935, 97, 662–666).—The volume magnetostriction effects of three samples of nickel are measured and compared with results to be anticipated from a knowledge of the thermal expansion of nickel. The results are contradictory for the higher field strengths employed.—J. S. G. T.

***Investigation of the Change of the Alternating-Current Resistance of Nickel in Longitudinal Magnetic Fields.** M. M. Sen Gupta, H. B. Mohanti, and S. Sharan (*Z. Physik*, 1935, 98, 262–266).—The hysteresis effect found in the case of the a.c. resistance of nickel in a longitudinal magnetic field is less than that characterizing the d.c. resistance. Moreover, no remanent resistance is found, and the mode of dependence of the resistance on the field strength is different in the two cases. The a.c. resistance–field strength curve is free from many of the irregularities found when d.c. is used.—J. S. G. T.

Magneto-Resistance Change of Nickel Studied with Alternating Current. M. M. S. Gupta, H. Mohanty, and S. Sharan (*Current Sci.*, 1935, 3, 351; *Brit. Chem. Abs.*, 1935, [A], 567).—Cf. preceding abstract. Effects with a.c. and d.c. are compared. Hysteresis is not found with a.c.—S. G.

***Influence of Phosphorus and Sulphur on the Mechanical Properties of Platinum and Palladium.** A. Jedele (*Z. Metallkunde*, 1935, 27, 271–275).—Small quantities of phosphorus in platinum or palladium and small quantities of sulphur in palladium increase the hardness, yield-point, and tensile strength, but decrease the ductility and working properties. Both metals become unworkable at 850° C. (hot-short) with about 0.005–0.006% phosphorus, and

palladium becomes hot-short with about 0.02% sulphur; these effects are due to the formation of readily fusible brittle compounds which are quite insoluble in the solid metal. The presence of sulphur in platinum has not nearly the same ill effects at high temperatures; even with 0.15% sulphur the metal is readily workable at 850° C., since the sulphide formed has a limited solubility in the metal. The tensile properties of alloys with up to about 1% of the non-metal are tabulated and characteristic photomicrographs of their structure are shown.—A. R. P.

*Alkali Films of Atomic Thickness on Platinum. Herbert Mayer (*Physikal. Z.*, 1935, 36, 845-848).—A method is described for preparing alkali films of atomic thickness, employing atomic rays, and the method is employed to investigate the photoelectric properties of platinum coated with such deposits of potassium.—J. S. G. T.

*The Emission of Positive Ions by Platinum when Heated in Oxygen. T. B. Rymer (*Proc. Roy. Soc.*, 1936, [A], 153, 422-442).—The variation with temperature of the positive ion emission from platinum heated in oxygen is examined experimentally and the results are satisfactorily interpreted in terms of Saha's theory.—J. S. G. T.

*On the Kinetics of the Precipitation of Silver by Metallic Lead from Silver Nitrate Solution. S. Krzyżanski (*Z. anorg. Chem.*, 1935, 225, 151-161).—The silver precipitated in unit time per unit area of a lead sheet immersed in silver nitrate solution is constant despite the progressive reduction in the concentration of silver in solution.—A. R. P.

*Revision of the Atomic Weight of Tantalum. Analysis of Tantalum Pentachloride. O. Hönigschmid and R. Schlee (*Z. anorg. Chem.*, 1935, 225, 64-68).—*Cf. Met. Abs.*, 1935, 2, 500. The value found was 180.88 ± 0.01 .—A. R. P.

†Intercrystalline Failure of Metals. J. C. Chaston (*Metal Treatment*, 1935, 1, 186-190).—Intercrystalline fractures in metals and alloys are surveyed. These are classified as caused by (1) failure of weak intercrystalline impurities; (2) weakness of the boundary cement at temperatures immediately below the melting point; (3) creep failure at the boundaries of stiffened alloys at temperatures in the recrystallization range; (4) selective boundary corrosion; (5) intercrystalline corrosion resulting from the simultaneous actions of stress and a specific corrosion agent; (6) imperfectly understood phenomena, some of which possibly involve the production of intense boundary stress concentrations. There is a *bibliography* of 24 references.—J. C. C.

†The Relation of Fatigue to Modern Engine Design. R. A. MacGregor, W. S. Burn, and F. Bacon (*Trans. N.E. Coast Inst. Eng. Ship.*, 1934-1935, 51, 161-228; discussion, D99-D136; and (review) *Metallurgist* (Suppt. to *Engineer*), 1935, 10, 18-19).—A paper in three distinct parts. In Part I a number of cases of failure in marine engine parts—principally crankshafts and tailshafts—are dealt with, and it is shown that these failures are initiated by impact at a stress raiser, corrosion-fatigue, heavy impact, or stress concentration resulting from various causes. The research work on the effect of discontinuities is also reviewed. Part II deals with a marine engine designer's problems especially the avoidance of stress raisers and of corrosion-fatigue. In Part III the evolution of certain modern views on elasticity and fatigue are discussed, and it is pointed out that the desirable properties, "notch-toughness" in fatigue and "high internal damping" tend to be related. Reference is also made to investigations on crack speed. An extended *bibliography* of 221 references is included.—J. W. D.

*Crystal Plasticity. IV.—Further Fundamental Considerations Relating to the Dynamical Law of Plasticity. E. Orowan (*Z. Physik*, 1935, 97, 573-595).—In continuation of previous work (*Met. Abs.*, 1934, 1, 481) it is shown that the extension limit is practically unaffected by relaxation occurring during the course of the experiment, so that its dependence on temperature and the velocity of deformation cannot, on a static basis, be regarded as attributable to

relaxation; these effects, more especially the latter, suggest the idea of a dynamical law of plasticity. Flow curves obtained with zinc crystals are given which, in accordance with Becker's formula, indicate a very marked dependence of the flow on temperature, and immediately suggest the dynamical character of the law of deformation. The characteristics of elastic "after-effect" are discussed.—J. S. G. T.

***Crystal Plasticity. V.—Completion of the Formula for the Velocity of Slip.** E. Orowan (*Z. Physik*, 1935, 98, 382–387).—The formula for the velocity of slip of a stressed crystal previously derived (*Z. Physik*, 1934, 89, 642–645) is completed by taking into account fluctuations of stress during the deformation. The actual velocity of slip now appears as the joint algebraic sum of a forward and a backward slip. The correction in the case of metallic crystals is practically nil, but can be of significance more especially in the case of organic crystals.—J. S. G. T.

The Variation of Plasticity with Temperature. H. Ekstein (*Z. Krist.*, 1935, 92, 253–274).—[In German.] The variation of the plasticity of tungsten and rock-salt with temperature agrees with that found for crystals previously examined, e.g. zinc and cadmium; in all cases the plasticity characteristics vary very little with temperature. It is concluded that the phenomenon of plasticity in crystals is essentially of an athermal character. Amorphous Bakelite shows a very large change of the initial plastic stress within the temperature range 16°–60° C.—J. S. G. T.

***The Significant Elasticity- and Deformation-Coefficients of Crystals, with Application to Isotropy.** P. Bechterew (*Z. Krist.*, 1935, 92, 1–29).—[In German.] A mathematical theory of crystal elasticity, applied principally to anisotropic bodies and contemplating four systems of dimensionless significant coefficients is developed.—J. S. G. T.

***Modulus of Elasticity of Materials for Small Stresses.** R. H. Evans and R. H. Wood (*Phil. Mag.*, 1936, [vii], 21, 65–80).—The value of Young's modulus, E , of steel, cast iron, glass, and other materials in compression is found to increase very considerably as the range of applied stress is increased from zero. Thereafter, in most cases, E decreases slightly, then increases slightly before falling to its final value. Values of E for a cast-iron column in extension, under small loads, decrease continuously to the final value as the load is increased. The results are explained in terms of a theory which contemplates the test column as composed of units some of which are in compression, some in tension.—J. S. G. T.

***The Frictional Oxidation at Solid Joints of Two Metals and Its Importance in Fatigue Fracture.** A. Thum and F. Wunderlich (*Z. Metallkunde*, 1935, 27, 277–280).—Frictional oxidation at metal-to-metal joints is caused by the fatigue of the metal and the consequent entry of oxygen into the surface layers. Evidence in support of this is afforded by experiments on steels subjected to fatigue tests in dry and oiled steel clamps.—A. R. P.

†**Gases in Metals.** C. J. Smithells (*Metal Treatment*, 1935, 1, 165–171).—Chairman's Address to the London Local Section of the Institute of Metals. A review is given of the factors which influence the adsorption and diffusion of gases in metals, present theories are outlined, and the relationship between these phenomena and the solubility of gases in solid metals is indicated.—J. C.

Metallic Surfaces and Thin Films. — (*Light Metals Research*, 1935, 4, 189–194; and *Light Metals Rev.*, 1936, 2, 197–202).—Summary of British Aluminium Co. Intelligence Memorandum I.D. 1/36. This is a review of the production, structure, and properties of thin metal films, with special reference to aluminium.—J. C. C.

Periodic Classification of the Rare Earths. Herman Yagoda (*J. Amer. Chem. Soc.*, 1935, 57, 2329–2330).—Some reasons are advanced in support of Brauner's arrangement of the rare earth elements in the periodic system.

—A. R. P.

Electron Microscope Investigation of Electron Emission from Cold Metals. A. Wehnelt and W. Schilling (*Z. Physik*, 1935, 98, 286-287).—The electron microscope is applied to examine electron emission from a "cold" cathode. Electrons are emitted from centres which appear suddenly from time to time at different points of the cathode surface.—J. S. G. T.

***Electron-Optical Photography of [Electron]-Emitting Wires.** H. Mahl (*Z. Physik*, 1935, 98, 321-323).—The electron-optical photography of electron-emitting wires is briefly described and photographs of emitting wires of tungsten, thoriated tungsten, and molybdenum are given.—J. S. G. T.

***Relation Between the [Electron] Emission Constants of Single- and Polycrystalline Material.** A. Recknagel (*Z. Physik*, 1935, 98, 355-362).—Values of the constants in the Richardson formula for electron emission from heated metals for polycrystalline, cubic, hexagonal holohedral crystals are derived, and compared with the corresponding values for single crystals.—J. S. G. T.

The Sparking Voltage of Electrolytic Valve Action. Werner Bar (*Z. Physik*, 1935, 98, 267-279).—Characteristics of the valve action of electrodes of tantalum, aluminium, antimony, bismuth, and tungsten in solutions of sulphuric acid, borax, and boric acid are investigated.—J. S. G. T.

On the Thermoelectric Effect According to the New Electronic Theory. Mizuho Satô (*Sci. Rep. Tôhoku Imp. Univ.*, 1935, [i], 24, 523-536).—[In German.] Mathematical considerations based on Bloch's theory give values for the thermoelectric power, and the Thomson and Peltier effects which agree with those deduced from the Sommerfeld theory only at low temperatures but are three times as great at high temperatures. In the latter case the thermoelectric properties are dependent on the Debye limiting frequency but at low temperatures such is not the case.—A. R. P.

***The Electrical Conductivity of Compressed Metallic Vapours.** Werner Braunbek (*Z. Physik*, 1935, 97, 482-495; and *Physikal. Z.*, 1935, 36, 891-892).—The dependence of the electrical conductivity of a metallic vapour on pressure can be calculated by Bloch's theory; it appears not altogether unreasonable that metallic vapours under sufficiently high pressures may conduct electricity like metals. Measurements with mercury vapour at pressures up to 35 atm., and with potassium vapour at pressures up to 10 atm. did not support this suggestion. Metallic conductivity of mercury vapour was less than 10^{-12} ohm.⁻¹ cm.⁻¹; while that of potassium vapour was less than 10^{-7} ohm.⁻¹ cm.⁻¹.—J. S. G. T.

Incandescence Electron Emission and Electron Conduction in the Case of Solids. A. Gehrts (*Physikal. Z.*, 1935, 36, 764-767).—Electron emission from a metal coated with a monatomic adsorption layer, e.g. from thoriated tungsten, is considered as a purely surface phenomenon, and is discussed from this point of view.—J. S. G. T.

***The Effect of Heat Abstraction on the Electrical Characteristics of Resistances the Value of Which Depends on Temperature.** H. Lueder and E. Spenke (*Physikal. Z.*, 1935, 36, 767-773).—Electrical characteristics of electrical resistances supplied with heat by leads and cooled in various manners are described and illustrated.—J. S. G. T.

The Change of Electrical Resistance and of Reflecting Power of Metallic Mirrors Condensed at Low Temperatures. R. Suhrmann and G. Barth (*Physikal. Z.*, 1935, 36, 843).—The electrical resistances of mirrors of copper, silver, gold, cadmium, thallium, and lead deposited at 20°-80° K. decrease on heating to room temperature, while the reflection coeffs. simultaneously increase. The electrical resistance of bismuth mirrors deposited at 80° K. increases as the temperature is raised to room temperature.—J. S. G. T.

The [Electrical] Resistance of Very Thin Films of Foreign Matter in Contacts Between Metals. R. Holm and B. Kirschstein (*Physikal. Z.*, 1935, 36, 882-888).—The values of contact resistances between metals are discussed. In

accordance with observations by Holm and Meissner, such resistances are shown to be independent of temperature, and to obey Ohm's law for values of voltage applied across the contact up to 0.5 v.—J. S. G. T.

An Elementary Theory of the Change of Resistance in a Longitudinal Magnetic Field. A. Sommerfeld and B. W. Bartlett (*Physikal. Z.*, 1935, 36, 894–899).—A wave-mechanical theory of the phenomenon of the change of electrical resistance of a metal in a longitudinal magnetic field is developed.

—J. S. G. T.

Electron Configuration in the Superconducting Metals. U. Dehlinger (*Physikal. Z.*, 1935, 36, 892–894).—It is suggested that all those elements, and only those, with crystal lattices of high co-ordination number with not too small values of their atomic radius, and which have more than 1 electron per atom in the outermost shell are superconducting elements. This holds for all elements, including the transition elements but excluding some weakly-superconducting elements in which case the presence of impurities possibly is of importance. The law possibly also applies to the superconducting alloys.

—J. S. G. T.

A Refinement of the Heisenberg Theory of Ferromagnetism, Applicable to Simple Cubic Crystals. Charles H. Fay (*Proc. Nat. Acad. Sci.*, 1935, 21, 537–542).—The method used in comparing the simple Heisenberg theory with the Gaussian distribution approximation is especially applicable to cubic crystals, and hence can be experimentally verified only in the case of certain alloys: the micro-crystal is regarded as consisting of units larger than the atom, but sufficiently simple to permit their unperturbed energy levels to be calculated. The results deduced on this assumption are in good agreement with the simple Heisenberg theory, and it is suggested that the latter is preferable to the Gaussian approximation.—P. M. C. R.

***Analysis of the Process of Technical Magnetization. I.—Experiments Relating to Weiss's Theory of the Technical Magnetization Curve.** K. H. R. Weber (*Z. Physik*, 1935, 98, 155–180).—Weiss's theory of magnetization, proposed in 1907, is briefly reviewed, and is confirmed by results obtained with a nickel wire. The theory, however, requires amendment in three directions, which are briefly discussed.—J. S. G. T.

The Dependence of Volume Magnetostriction and the Weiss Factor on Temperature and the Lattice Constants. M. Kornetzki (*Z. Physik*, 1935, 98, 289–313).—A ferromagnetic material exhibiting volume magnetostriction in the region of technical saturation is found to be characterized by a change of spontaneous magnetization accompanying a change of pressure. To explain this, it is assumed that the Weiss factor and the Curie point of the material depend on its volume. A theory, correlating displacement of Curie point with change of volume, is developed. The change of volume is correlated with the lattice constants, and the theory indicates that the volume magnetostriction effect in the paramagnetic range increases with the square of the field strength. This effect is measured for iron, iron-nickel alloys, and a nickel-copper alloy in the temperature range 20°–90° C., and the theory confirmed in some respects. Satisfactory agreement is obtained between the number of magnetons per atom calculated from susceptibility data and that derived from saturation data. The Weiss factor, N , is found to be about 7000 in the region of the Curie point. The magneto-caloric effect is discussed in connection with Potter's results (*Proc. Roy. Soc.*, 1934, [A], 146, 362).

—J. S. G. T.

II.—PROPERTIES OF ALLOYS

(Continued from pp. 3-7.)

***Magnetic Investigation of Precipitation-Hardening [of Aluminium-Copper Alloys].** Hermann Auer (*Physikal. Z.*, 1935, 36, 880-882).—The changes of paramagnetic susceptibility of aluminium-copper alloys during the improvement (*Vergütung*) process are investigated. A marked decrease in the value of the susceptibility (measured at 20° C.) occurs when the alloys are quenched from a suitable temperature. The velocity of transformation (u) at temperature T follows the law, $u = B + A/T$. The stoichiometric composition of the precipitated intermetallic compound (CuAl_2) can be determined from the susceptibility measurements. The dependence of susceptibility of pure aluminium and of the alloys after attaining precipitation-equilibrium is in accordance with an extended form of Curie law.—J. S. G. T.

***Researches to Determine the Best Hardening Temperature for Duralumin Alloys.** U. von Scheidt (*Z. Metallkunde*, 1935, 27, 275-277).—The best quenching temperature for Duralumin containing copper 4-4.2, magnesium 0.5-0.8, silicon 0.2-0.4, and manganese 0.35-0.65% is 510°-515° C.; these alloys blister when heated at about 530° C. and after heating at 535° C. or higher a serious reduction in strength and ductility occurs. Duralumin with copper 3.6, magnesium 1.1, silicon 0.6, and manganese 1.1% fails at 520° C. and should therefore not be heated above 505° C. during heat-treatment.

—A. R. P.

***X-Ray Investigation of the Equilibrium Diagram of Aluminium-Lithium Alloys, and the Structure of the AlLi Compound.** G. Komovsky and A. Maximow (*Z. Krist.*, 1935, 92, 275-283).—[In German.] The equilibrium diagram of aluminium-lithium alloys containing from 0 to 20.5% of lithium has been investigated by X-ray analysis; the existence of two phases (α and β) is confirmed. The β -phase is constituted of an intermetallic compound, AlLi , having a cubic crystal lattice with $a = 6.37 \text{ \AA}$., and a unit cell containing 16 atoms. The character of the α -phase was not accurately ascertained; the lattice parameters of the α -phase are the same as those of pure aluminium.—J. S. G. T.

The Properties of Silumin Containing Magnesium. G. Sachs and E. Scheuer (*Metallwirtschaft*, 1935, 14, 937-941, 972-975; and (summary) *Light Metals Rev.*, 1935, 2, 187-190).—The properties and uses of cast γ -Silumin (silicon 12, manganese 0.4, magnesium 0.5%) are discussed. Combined with excellent mechanical properties the alloy has good castability which renders it suitable for large and complicated castings of high strength. Quenching after casting in no way adversely affects the tensile properties. Hints for casting and heat-treatment are given and the influence of faults in the treatment is discussed.—v. G.

Cadmium-Nickel Bearing Alloys. A. J. Phillips (*Machinist (Eur. Edn.)*, 1935, 79, 709-710E).—Cadmium-nickel bearing alloys consist essentially of pure cadmium with 1.3% of nickel and stiffening additions of copper, magnesium, silver, and even zinc. Microscopically they resemble an ordinary tin-base bearing alloy. They have a coeff. of friction slightly lower than that of S.A.E. 12 Babbitt, a fatigue strength of about 3800 lb./in.² (20×10^6 reversals), and a high melting point, the initial softening temperature being 604° F. (318° C.).—J. H. W.

***The Modulus of Elasticity of Copper-Beryllium Alloys.** Léon Guillet (*Compt. rend.*, 1935, 201, 960-962).—Copper-beryllium alloys containing 2-18.5% of beryllium were cast and annealed for 8 hrs. at 800° C. Micro-examination confirmed the equilibrium diagram of Masing and Dahl. Determinations were made of the Rockwell hardness B and the modulus of elasticity

in bending. The hardness increased linearly with the beryllium content in the 2-constituent region, but the modulus increased throughout the whole range investigated. Beryllium appreciably increased the modulus of elasticity of copper, an alloy containing 15% beryllium having a modulus equal to that of steel. The high modulus of elasticity and the low density of beryllium explains the variation of the ring (number of transverse vibrations/second) of these alloys with the beryllium contents.—J. H. W.

Copper-Lead Bearings. D. E. Anderson (*Machinist (Eur. Edn.)*, 1935, 79, 723-724E).—Describes the properties and structure of copper-lead bearing alloys containing about 30% lead, and the requirements of these alloys for satisfactory performance.—J. H. W.

***Temper-Hardening of Commercial Nickel-Coppers Containing Phosphorus.** E. C. Rollason and T. G. Bamford (*Metals and Alloys*, 1935, 6, 345-346, 349).—The presence of small amounts of phosphorus in alloys of copper with 1-3% nickel produces precipitation-hardening after suitable heat-treatment. Thus, when copper containing nickel 1.73 and phosphorus 0.11% is quenched from 750° to 800° C. and reheated at 500° C. for 30 minutes, the tensile strength increases from 14.7 to 23 tons/in.², the elastic limit from 0.8 to 7 tons/in.², and the Brinell hardness from 42 to 82. Curves are given showing the effects of time and temperature of precipitation treatment on the hardness obtained.—A. R. P.

***Bronzes Formed with a Copper-Nickel-Tin Base, Capable of Being Hardened.** VI.—**The Addition of Cold[-Working] Hardening and Precipitation-Hardening.** Erich Fetz (*Z. Physik*, 1935, 97, 690-698).—Results with copper-tin alloys containing small proportions of nickel (2.5-3%) support the hypothesis that cold-working influences the atoms themselves as it is found that an addition of cold-working hardness and precipitation-hardness is possible even if the latter is smaller than the former. With increasing strain the additional precipitation effects become less; this is attributed to a directed diffusion and a vectorial increase of crystal nuclei. The maximum attainable strength of the tin-bronzes containing small proportions of nickel, capable of being hardened, is independent of the order in which hardening by cold-working and precipitation is effected. A very considerable acceleration of separation into components of the α -solution is observed in the cold-worked alloys, and is associated with an increase of total lattice energy.—J. S. G. T.

***Contribution to the Copper-Zinc [Equilibrium] Diagram.** J. Schramm (*Metallwirtschaft*, 1935, 14, 995-1001, 1047-1050).—Slight modifications of the phase boundaries in Bauer and Hansen's diagram are made as the result of very exact temperature measurements.—v. G.

The Mallechorts (Nickel Silvers). — (*Machines*, 1935, 12-13).—The commercially useful ranges of the ternary copper-nickel-zinc alloys are indicated on a constitutional diagram, and briefly described. The method of production is discussed, and suitable precautions regarding material, protection of the melt, deoxidation, and pouring are enumerated. Methods of cleaning the cast material are described.—P. M. C. R.

***On the Diffusion of Carbon, Silicon, and Manganese in Solid and Liquid Iron.** Max Paschke and Alexander Hauttmann (*Arch. Eisenhüttenwesen*, 1935-1936, 9, 305-309).—At 1400° C. the coeff. of diffusion of manganese into solid iron is 0.83×10^{-2} cm.²/day, and at 1600° C. the coeff. of diffusion of manganese into liquid iron is 9.6 cm.²/day.—A. R. P.

***The Melting-Time of [Electric Circuit] Fuses.** J. A. M. van Liempt and J. A. de Vriend (*Z. Physik*, 1935, 98, 133-140).—In continuation of previous work (*Met. Abs.*, 1935, 2, 644). Meyer's formula for the relation between time of fusion (t) and current strength (I) is established for thin wires of Monel metal and for values of I up to 20 times the limiting value. The formula $I^2t = \text{constant}$ is also found to hold for various forms of fuses used in domestic wiring systems.—J. S. G. T.

*The System Nickel-Manganese.—II. S. Valentiner (*Z. Physik*, 1935, 97, 745-757).—Cf. *Met. Abs.*, 1935, 2, 421. The change of resistance of nickel-manganese due to a magnetic field is investigated at various temperatures between 14° and 300° C. Values of $(\Delta R/R_0) \times 10^4$ between -25 and +140 were found. Alloys containing up to 20% manganese showed a normal behaviour up to about the region of the Curie point. Alloys containing 25 and 30% manganese, owing to the effect of spontaneous magnetization, behaved abnormally, negative values of $\Delta R/R_0$ being found in moderate fields even well below the Curie point.—J. S. G. T.

†The Mechanical Properties of Tin-Base Alloys. D. J. Macnaughtan and B. P. Haigh (*Tech. Publ. Internat. Tin Res. Develop. Council*, 1935, [A], (26), 12 pp.; and *Met. Ind. (Lond.)*, 1935, 47, 441-444, 448).—Read before the International Congress on Mining, Metallurgy, and Applied Geology, Paris, 1935. The effects of the time-factor on tensile, compression, hardness, and fatigue tests of tin-base alloys are discussed, especially with regard to the phenomena of creep and self-annealing. Published work on the effect of different alloying elements on the properties of tin is reviewed.—E. S. H.

*Phase Changes During Ageing of Zinc-Alloy Die-Castings. II.—Changes in the Solid Solution of Aluminium in Zinc and Their Relation to Dimensional Changes. M. L. Fuller and R. L. Wilcox (*Metals Technology*, 1935, 2, (Dec.); *A.I.M.M.E. Tech. Publ.* No. 657, 13 pp.).—Ageing at room temperature of die-castings of an alloy of zinc with 4% aluminium and 0.04% magnesium results in a slow separation of the γ -phase from the α -solid solution due to the change in solubility of aluminium in zinc from 0.78% at 375° C. to about 0.04% at 20° C. This separation results in shrinkage, and a subsequent anneal at 150°-175° C. of castings dimensionally stabilized at room temperature produces a redissolution of γ and a corresponding expansion. Stabilization of die-castings at 95° C. for 3 hrs. produces a more rapid separation of γ and therefore a more rapid shrinkage, but on storage at room temperature castings that have received this stabilization treatment undergo a further small shrinkage. This work indicates that all the dimensional changes that occur in normal ageing are due to changes in the α -phase and that the β -transformation contributes practically nothing to the observed shrinkage.—A. R. P.

*The Constitution of Liquid Zinc Amalgams. Herman A. Liebafsky (*J. Amer. Chem. Soc.*, 1935, 57, 2657-2662).—Re-examination of e.m.f. data for zinc amalgams affords strong indirect evidence that the zinc is present as Zn , Zn_2 , and Zn_3 molecules in rapid equilibrium with one another.—A. R. P.

*The Exact Measurement of the Specific Heats of Solid Substances at Higher Temperatures. XX.—On the Molecular Heats of the Alloys of Palladium and Antimony in Comparison with the Sum of the Atomic Heats of the Free Elements. XXI.—On the Molecular Heat of the Compound $PbSb_2$ in Comparison with the Sum of the Atomic Heats of the Free Composing Elements. XXII.—The Molecular Heats of the Supposed Binary Compounds of Copper and Palladium. T. J. Poppema and F. M. Jaeger (*Proc. K. Akad. Wet. Amsterdam*, 1935, 38, 822-833, 833-836, 836-841).—[In English.] (XX.—) The atomic heat, C_p , of palladium at $t^\circ C.$ is given by $C_p = 6.2288 + 0.12862 \times 10^{-2}t + 0.27528 \times 10^{-7}t^2$. In the binary system of palladium-antimony alloys three stable compounds, viz. $PdSb$ (melting point 802° C.), $PbSb_2$ (melting point 676° C.), and Pd_3Sb (melting point 1218° C.) occur. Structural details of crystals of these alloys are given. The true specific heats, c_p , of granulated antimony at $t^\circ C.$ between 192° and 577° C. are given by $c_p = 0.048671 + 0.4832 \times 10^{-5}t + 0.31179 \times 10^{-7}t^2$. The atomic heat at $t^\circ C.$ is given by $C_p = 5.8501 + 0.5808 \times 10^{-3}t + 0.37477 \times 10^{-5}t^2$. Values of c_p and C_p for massive antimony are given by: $c_p = 0.050055 - 0.10004 \times 10^{-5}t + 0.40512 \times 10^{-7}t^2$; $C_p = 6.0952 - 0.12182 \times 10^{-3}t + 0.49331 \times 10^{-5}t^2$. There is no evidence of a transformation point above 413° C. The specific heats of

antimony depend on the size of grain. Values of c_p and the molecular heat C_p' for the compound PdSb are given by: $c_p = 0.0518615 + 0.171176 \times 10^{-4}t$; $C_p' = 11.8484 + 0.39104 \times 10^{-2}t$. These values are for temperatures between 190° and 600° C. Values of c_p and C_p' for PdSb₂, between 200° and 600° C. are given by $c_p = 0.048460 + 0.25202 \times 10^{-4}t$; $C_p' = 16.9716 + 0.88264 \times 10^{-2}t$. Values of c_p and C_p' for Pd₃Sb between 200° and 940° C. are given by $c_p = 0.05169 + 0.3416 \times 10^{-4}t - 0.61203 \times 10^{-7}t^2 + 0.5372 \times 10^{-10}t^3$; $C_p' = 22.7591 + 0.015041t - 0.26947 \times 10^{-4}t^2 + 0.23653 \times 10^{-7}t^3$. The heat effect accompanying the $\beta \rightarrow \alpha$ transformation at about 940° C. has the value -4882 cal./gram. Deviations from the additive law of Neumann-Kopp-Regnault are only small. They increase with the percentage of palladium in the compounds and the corresponding increasing melting point; they are greatest (3–6%) for Pd₃Sb and negative; they are smallest (1.5–2%) for PdSb₂ with a maximum at 400° C. and an oscillating algebraic sign. For PdSb they are negative and vary from 1 to 4%. (XXI.—) Values of c_p and C_p' of the compound PtSb₂ at temperatures, t , between 0° and 629° C. are given by $c_p = 0.03820 + 0.132496 \times 10^{-4}t - 0.78762 \times 10^{-9}t^2$; $C_p' = 16.6400 + 0.577143 \times 10^{-2}t - 0.35108 \times 10^{-5}t^2$. Deviations from the Neumann-Kopp-Regnault "law" are very large, negative, and a function of the temperature. The largest deviation is -19% . (XXII.—) Crystal data relating to the respective structures of the compounds CuPd and Cu₃Pd are given. Values of c and C_p' for CuPd are given by $c_p = 0.065396 + 0.41082 \times 10^{-4}t - 0.266055 \times 10^{-7}t^2$; $C_p' = 11.1346 + 0.699483 \times 10^{-2}t - 0.453 \times 10^{-5}t^2$. The values hold for temperatures, t° C., between 196° and 900° C. For the compound Cu₃Pd values of c_p and C_p' at temperatures t° C. between 200° and 900° C. are given by $c_p = 0.07345 + 0.50164 \times 10^{-4}t - 0.208332 \times 10^{-7}t^2$; $C_p' = 21.8445 + 0.14919 \times 10^{-1}t - 0.6196 \times 10^{-5}t^2$. Variations from results calculated by the Neumann-Kopp-Regnault law do not, in the case of each compound, exceed -5.3% in the case of CuPd, and $+5.7\%$ for Cu₃Pd.—J. S. G. T.

Permeability to Hydrogen of Copper, Iron, Nickel, Aluminium, and Some Alloys. (Baukloh and Kayser.) See p. 30.

On a Particular Phenomenon in Transformations Which Extend over a Temperature Range. A. Schulze (*Z. Metallkunde*, 1935, 27, 251–255)—In systems in which transformations occur over a temperature range, e.g. magnetic transformations or the change from regular to random orientation, the curves of electrical resistance, temperature coeff. of electrical resistance, and thermal expansion all show deviations from a linear course at temperatures just below the beginning of the transformation range. This anomaly is illustrated by curves for gold-copper, iron-nickel, and β -brass alloys and for the magnetic transformations in nickel and iron.—A. R. P.

On the Theory of Transformations in Metallic Solid Solutions.—III. G. Borelius (*Ann. Physik*, 1935, [v], 24, 489–506).—The subject is discussed on thermo-dynamical principles.—v. G.

III.—STRUCTURE

(Metallography; Macrography; Crystal Structure.)

(Continued from pp. 7–8.)

Tentative Recommended Practice for Metallographic Testing of Ferrous and Non-Ferrous Metals (E 3–35 T). — (*Book of A.S.T.M. Tentative Standards*, 1935, 1445–1477; and *Proc. Amer. Soc. Test. Mat.*, 1935, 35, (I)).—This is in effect a tentative revision of, and is intended to replace when adopted, the present Standard Methods (E 3–24 and E 5–27). It deals with iron and steel, aluminium and its alloys, copper and its alloys, lead and its

alloys, magnesium and its alloys, nickel and its alloys, precious metals, tin and its alloys, and zinc and its alloys, and gives tables of etching reagents, with remarks on their use. A bibliography of 94 references is appended.—S. G.

Preparing Metals for Microscopy. F. F. Lucas (*Bell Lab. Record*, 1935, 14, 116-120).—Recommended procedure involves grinding on Aloxite papers and polishing first with Alundum powder and water on a horizontal broadcloth-covered wheel and finally with magnesium oxide and water on another wheel covered with "Kitten's ear." An air separator for preparing suitably fine magnesium oxide, having an average particle diameter of 0.176μ , is described.

—J. C. C.

Phase Contrasts Applied to Microscopic Observation. F. Zernike (*Physikal. Z.*, 1935, 36, 848-851).—Abbe's theory of microscopic vision is briefly explained. A method for improving microscopic vision, employing a "phase-plate" device whereby only the direct light wave is changed in phase, is described.

—J. S. G. T.

***Researches on the Diffraction of Electrons by Metals and Organic Polymers.** J. J. Trillat and H. Motz (*Ann. Physique*, 1935, [xi], 4, 273-304).—Certain abnormalities in the electron diffraction patterns obtained with organic polymers and metals have been investigated. Thin films of gold (30-40 $\mu\mu$ thick), prepared by electrolysis using every biological precaution to exclude impurities of any kind, did not show the supplementary rings usually found. These appeared, however, on applying thin films of paraffin, stearic acid, and similar fatty bodies to the surface of the gold. It is concluded that these "abnormal" diagrams are produced by the crystallization, more or less rapid, of very thin films of fatty materials having molecules with long carbon chains, and derived from the impure air of the laboratory. The films can be removed by very careful washing with benzene or ether, or, preferably, can be destroyed by allowing a sufficiently intense beam of electrons to impinge for 15-30 minutes on the point to be studied. A bibliography of 24 references is appended.—J. C. C.

***The Distortion of β -Brass and Iron Crystals.** C. F. Elam (Mrs. G. H. Tipper) (*Proc. Roy. Soc.*, 1936, [A], 153, 273-301).—No essential difference is found between the distortion in tension of body-centred cubic crystals of iron and β -brass. Although slip-bands agreeing with possible crystal planes—chiefly {110} planes and less frequently {112} planes—are usual, calculations of the distortion do not agree with the occurrence of slip on these planes throughout the extension. The direction of slip is not always a [111] direction, although this is the most common found. It is suggested that deformation does not take place by slip on any definite crystal plane, but that distortion is effected by complicated movements originally related to the structure but finally having no obvious connection with it; the facts that the distortion cone usually consists of two planes limits the possibilities. Stress-strain curves of the crystals are given, and the fracture of β -brass crystals in tension and in rolling is described.—J. S. G. T.

***X-Ray Determination of the $MgNi_2$ Structure.** E. F. Bachmetew (*Metallwirtschaft*, 1935, 14, 1001-1002).—The compound has $a = 4.802$, $c = 15.82$ A. Possible atomic arrangements are discussed.—v. G.

Remarks on the Foregoing Paper of E. F. Bachmetew: "X-Ray Determination of the $MgNi_2$ Structure." F. Laves and H. Witte (*Metallwirtschaft*, 1935, 14, 1002).—Cf. preceding abstract. Additional data on the subject are given.—v. G.

Note on $MgZn$ and $MgZn_5$. L. W. McKeehan (*Z. Krist.*, 1935, 91, 501-503).—[In English.] McK. suggests that the crystal structures of $MgZn$ and $MgZn_5$, given by Tarschisch (*Met. Abs.*, 1934, 1, 299), require more experimental verification before they can be regarded as established.—J. S. G. T.

***The Law of Melting Points and Lattice Structure.** Robert Forrer (*Ann. Physique*, 1935, [xi], 4, 202-269).—By suitable choice of values for the number

of "contacts" N between certain exterior orbits of the atom, it has been found possible to use the same factor F (about 300°C .) in the expression for the Curie point $T = F\sqrt{N}$, and obtain the absolute melting point. Melting occurs when the "contacts" between the electrons in these outer orbits are ruptured. The number of electrons involved is 1 for Li, Na, K, Rb, Cs, Ga, In, Tl, Zn, Cd, Bi, Sn; 2 for Pb and Mg; 3 for Ce, La, Cu, Ag, and Au.

—J. C. C.

***Precision Determination of the Lattice Constants of Silicon.** M. C. Neuberger (*Z. Krist.*, 1935, 92, 313-314).—[In German.] The length of edge (a) of the cubic crystal lattice of silicon at 20°C . is found to be $5.4173 \pm 0.0005\text{ \AA}$. Values of other lattice constants are derived by calculation.—J. S. G. T.

***Investigations Relating to the Dendritic Growth of Crystals.** A. Papapetrou (*Z. Krist.*, 1935, 92, 89-130).—[In German.] The growth of dendritic crystals of various chemicals from solutions and melts is investigated by means of the microscope. The results indicate that dendritic growth is the joint result of anisotropy of velocity of growth and of diffusion. Effects due to surface tension at curved surfaces are observed and discussed.—J. S. G. T.

Relationships in the Hexagonal Atomic Lattice and the Reciprocal Lattice in the Case of Four-Co-Ordinate Systems of Symbols. Ingeburg Schaake (*Z. Krist.*, 1935, 91, 466-472).—[In German.] The four-co-ordinate system of crystallographic description as applied to hexagonal crystals is described. The treatment is entirely mathematical.—J. S. G. T.

***The Electron-Optical Structure Image and Its Evidence Concerning the Emission-Characteristics of Barium-Nickel (Incandescent) Cathodes.** E. Brüche (*Z. Physik*, 1935, 98, 77-107).—The electron microscope is applied to study the characteristics of emission of electrons from incandescent cathodes. In the case of a barium-nickel cathode the barium is found to wander about over the surface of the nickel support. The energy of electron emission, electron-emission measurement effects considered as averages, the Schrot and similar effects are briefly discussed.—J. S. G. T.

†The X-Ray Powder Photography of Alloys. A. J. Bradley (*Met. Ind. (Lond.)*, 1935, 47, 611-613; discussion, 613-619).—Abstract of a lecture to the Midland Metallurgical Societies (Birmingham Local Section of the Institute of Metals, Birmingham Metallurgical Society, and Staffordshire Iron and Steel Institute) and the Midland Section of the Institute of Physics. See *Met. Abs.*, this vol., p. 7.—J. H. W.

Calculation of the Intensities of Interference Lines on Debye-Röntgen Diagrams. N. Zelljakoff, A. Stefanowsky, and J. Hurgin (*Z. Physik*, 1935, 98, 66-71).—It is shown that, in calculating the intensities of interference lines in X-ray diagrams obtained by the Debye powder method, the width of the beam reflected must be taken into account before satisfactory agreement between experimental and calculated values can be obtained.—J. S. G. T.

A Back-Reflection Laue Method for Determining Crystal Orientation. Alden B. Greninger (*Z. Krist.*, 1935, 91, 424-432).—[In English.] The basis of the back-reflection Laue method is as follows: a beam of "white" X-rays, limited by a suitable pinhole system, passes normally through a hole in a photographic film, strikes the crystal, and is diffracted back to the film. One photograph, which can be taken in less than an hour and interpreted in a few minutes, completely establishes the crystal orientation. The method is particularly applicable to the study of most metallic crystals. For metals such as copper and iron, efficient filtering of secondary X-radiation is obtained by arranging a sheet of aluminium 0.01 in. thick in contact with the film.

—J. S. G. T.

Simplified Technique for Lattice Parameter Measurements. John J. Norton (*Metals and Alloys*, 1935, 6, 342-344).—Describes a simple X-ray apparatus and some results obtained by its use. The original must be consulted for details.—A. R. P.

IV.—CORROSION

(Continued from pp. 8-10.)

The Corrosion of Tinsplate. T. P. Hoar (*Proc. Swansea Tech. Coll. Met. Soc.*, 1936, (Jan.), 13 pp.).—Discusses the corrosion of tin and steel alone, and in galvanic couple. The relation of their actions to the corrosion of tinsplate is also indicated.—R. Gr.

*A Laboratory Study of the Atmospheric Corrosion of Metals. II.—Iron: the Primary Oxide Film. III.—The Secondary Product or Rust (Influence of Sulphur Dioxide, Carbon Dioxide, and Suspended Particles on the Rusting of Iron). W. H. J. Vernon (*Trans. Faraday Soc.*, 1935, 31, 1668-1700).—(II.—) Marked differences in the properties of the oxide film on iron are observed according to whether the film is formed above or below a critical temperature of 200° C. The weight increment-time curves also show a point of inflection at this temperature, the equation $W^2 = kt$ being applicable above 200° C. and $W^{2.5} = kt$ below 200° C. As is the case with zinc, the oxide first formed is pseudomorphic with iron; but when unit cell dimensions have been completed further thickening proceeds by diffusion through the lattice. (III.—) Differences in the behaviour of iron and zinc in moist air containing traces of sulphur dioxide are ascribed to secondary critical humidity phenomena; at the primary critical humidity the magnitude of the change is almost the same for both metals, but at the secondary point there is a rapid increase in the rate of attack for iron and only a trifling increase for zinc. Copper behaves similarly to zinc except that after the secondary point the attack on zinc is linear whereas that on copper falls off rapidly. The presence of ammonium sulphate particles in the air has little effect on the corrosion of zinc, but a profound effect, under certain conditions, on the corrosion of iron; this difference is also ascribed to the relative inertness of zinc to secondary critical humidity.—A. R. P.

*Corrosion Tests on Galvanized Sheet by Preece's Immersion Method and by Schreiber's Boiling Method. Franz Schreiber (*Illust. Zeit. Blechindustrie*, 1935, 64, 1446-1447).—Corrosion tests by these methods were carried out on 3 types of "Alplataer" (galvanized) zinc sheet, pure zinc sheet, and sheet galvanized with zinc containing additions of aluminium. One type of "Alplataer" resisted the action of boiling water almost as well as pure zinc; the alloy-coated sheet showed rapid deterioration under both methods of testing. S. emphasizes the danger of including aluminium in the galvanizing bath.—P. M. C. R.

*Oxide Film of Alloys Containing Small Percentages of Aluminium. Ichirô Itaka and Shizuo Miyake (*Nature*, 1935, 136, 437).—When copper alloys containing more than 2% aluminium were heated for many hours at 800°-900° C., no oxide scales were formed. Alloys containing about 10 atomic-% aluminium, when heated in an insufficient supply of oxygen, became covered with a colourless film of pure aluminium oxide.—E. S. H.

Methods of Investigating Corrosion. Nathalie Goldowski (*La Nature*, 1935, (2957), 69-72; and *Ann. Postes, Télégr. Téléph.*, 1935, 24, 1002-1010).—Corrosive attack is considered mainly in its relation to aviation and marine construction. Sea-water is here the most important medium of attack: its variations and the methods of reproducing them artificially are considered. An account is given of marine exposure tests, and of laboratory methods (alternate immersion and drying, salt-spray, accelerated attack by oxygen and by oxygenated water). Methods of estimating the degree of corrosion are briefly described.—P. M. C. R.

V.—PROTECTION

(Other than Electrodeposition.)

(Continued from pp. 10–12.)

Protection and Decoration of Aluminium and Its Alloys by Anodic Oxidation. — (*Industrie élect.*, 1935, 44, 541–549).—A general account of the principles and applications of the chief processes used for the anodic oxidation of aluminium.—J. C. C.

The Films Responsible for the Colours on Molten Lead, Tin, Bismuth, and Zinc. H. A. Miley and U. R. Evans (*Chem. and Ind.*, 1936, 55, 31–33).—The technique for removing oxide films mechanically from the surfaces of the metals is described. Addition of a trace of zinc causes a rapid increase in the rate of surface oxidation of tin and, to a less extent, of lead.—E. S. H.

Corrosion After Pickling Major Source of Galvanizer's Dross. Wallace G. Imhoff (*Iron Age*, 1935, 136, (23), 30–33, 116, 118).—Experimental results show that one of the most prolific sources of galvanizer's dross is corrosion after pickling and during drying. The reducing action of molten zinc and the ferric oxide formed by corrosion have been studied in this connection.—J. H. W.

Tentative Specifications for Zinc-Coated (Galvanized) Wrought-Iron Sheets (A 163–35 T). — (*Book of A.S.T.M. Tentative Standards*, 1935, 234–238; and *Proc. Amer. Soc. Test. Mat.*, 1935, 35, (I)).—Cover wrought-iron sheets for use in culverts, roofing, siding, for corrugating and moderate forming, with four classes of zinc coatings applied by the hot-dip process: *A* and *B*, extra-heavy and heavy coated sheets that are not intended to be formed other than by corrugating and curving to large radii; *C*, moderately heavily coated sheets for moderate bending, and *D*, ordinary sheets for general utility.—S. G.

VI.—ELECTRODEPOSITION

(Continued from pp. 12–13.)

The Spotting-Out of Cadmium Deposits. — (*Met. Ind. (Lond.)*, 1935, 47, 521–523).—Report of a discussion held at the Midlands Centre of the Electrodepositors' Technical Society.—J. H. W.

Tentative Specifications for Electrodeposited Coatings of Cadmium on Steel (A 165–35 T). — (*Book of A.S.T.M. Tentative Standards*, 1935, 214–215; and *Proc. Amer. Soc. Test. Mat.*, 1935, 35, (I)).—Cover electroplated cadmium coatings on steel that are required to withstand corrosion. Two types of coating are covered: Type NS, for general service, and Type TS, for mild service.—S. G.

Influence of Various Acid Radicals on Chromium Hardness. R. J. Piersol (*Metal Cleaning and Finishing*, 1935, 7, 325–328, 385–387).—Addition of acid radicals other than sulphate or borate tends to reduce the hardness of chromium deposits and spoil their appearance; a combination of fluoride, chloride, and phosphate which has been recommended in some quarters gives an improved plate for a short time after making up a new bath, but the operation of the bath rapidly deteriorates.—A. R. P.

Influence of the Borate Radical on Chromium Hardness. R. J. Piersol (*Metal Cleaning and Finishing*, 1935, 7, 487–490).—Addition of 2–10 grm./litre of boric acid to the ordinary chromium plating bath makes the plate whiter (the bluish tinge common to plated chromium is almost completely removed), reduces the resistance of the bath and admits of faster plating, and permits iron anodes to be used without fear of producing an excessive concentration of trivalent chromium ions.—A. R. P.

***Influence of Bath Temperature on Chromium Hardness.** R. J. Piersol (*Metal Cleaning and Finishing*, 1935, 7, 535-537).—Tests were carried out on the hardness of chromium plates produced at various temperatures and at various rates of deposition from a bath containing chromic acid 250, sulphuric acid 2-6, and boric acid 10 grm./litre after electrolysis with lead anodes to obtain a concentration of 2 grm./litre of trivalent chromium. At 135° F. (57° C.) the hardness increases with the rate of deposition of chromium to a maximum at 0.002 in./hr. then decreases, but at 155° F. (74° C.) there is no decrease in hardness with more rapid deposition once the maximum hardness is obtained. For constant rates of deposition the hardness of the deposit increases markedly with increase in plating temperature.—A. R. P.

Laminated Chromium Deposits. R. J. Piersol (*Metal Cleaning and Finishing*, 1935, 7, 587-590).—Contrary to statements which have appeared in the literature, a short interruption of plating during deposition of chromium does not result in peeling. In fact a thick deposit of chromium which does not crack cannot be built up by continuous plating, but only by plating for 5 minutes, raising the articles from the bath for 30-60 seconds to allow hydrogen to escape and replating for 5 minutes, and so on; in this way hard, adherent, laminated deposits have been obtained up to 0.005 in. thick.—A. R. P.

Gold-Plating Methods. W. A. Koehler (*Metal Cleaning and Finishing*, 1935, 7, 591-593).—A brief description is given of modern methods of gold-plating.—A. R. P.

Tentative Specifications for Electrodeposited Coatings of Nickel and Chromium on Steel (A 166-35 T). — (*Book of A.S.T.M. Tentative Standards*, 1935, 216-219; and *Proc. Amer. Soc. Test. Mat.*, 1935, 35, (I)).—Cover electroplated coatings on steel articles, including a final coating of nickel or chromium where both appearance and protection against corrosion of the base metal are important. Two types of coating are covered: Type KS, for general service, and Type QS, for mild service.—S. G.

Examination of Nickel-[Plating] Baths and Nickel Plating Salts. II.—The Quantitative Determination of Boric Acid and Citric Acid. (Raub and Nann.) See p. 47.

Tentative Specifications for Electrodeposited Coatings of Zinc on Steel (A 164-35 T). — (*Book of A.S.T.M. Tentative Standards*, 1935, 212-213; and *Proc. Amer. Soc. Test. Mat.*, 1935, 35, (I)).—Cover requirements for electroplated zinc coatings on steel articles that are required to withstand corrosion. Two types of coating are covered: Type LS, for general service, and Type RS, for mild service.—S. G.

Bright Zinc. C. M. Hoff (*Metal Cleaning and Finishing*, 1935, 7, 483-486, 490).—Owing to the recent rapid increase in the price of cadmium, zinc plating is replacing cadmium plating in many American plants. Bright plates and good throwing power are obtained only from cyanide baths. The operation of certain proprietary baths is described and the relative costs of zinc and cadmium plating are discussed.—A. R. P.

***Study of the Throwing Power of Electrolytic Baths.** Albert Portevin and Michel Cymboliste (*Compt. rend.*, 1935, 201, 819-821).—In order to overcome difficulties experienced in a previous investigation (*Met. Abs.*, 1935, 2, 473-474) and to increase the applicability of the tests, test-pieces are used consisting of 2 coaxial helices through which the electrolyte can freely circulate. These helices are 5 and 20 mm. in diameter, each having a surface area of 10 cm.², and are made of fine wire 0.5 mm. in diameter. Two non-conducting screens protect the extreme spirals, thus allowing the formation of an adherent and practically uniform deposit throughout the length. The increases in weight, p and P , of the inner and outer helices are measured, whence the throwing power, $\Pi = \frac{p}{P} \times 100$. The effect on the current efficiency, conductivity, and

throwing power of a number of variables has been studied, with the following results: (1) as the current density increases, Π decreases, except in certain cadmium or chromium baths; (2) as the temperature increases, Π decreases for copper, cadmium, and zinc, but increases for nickel in dilute baths, although it varies but little for chromium in concentrated baths, and in general with high current densities; (3) as the concentration of salts of the metal to be deposited increases, Π increases with nickel baths up to a certain limit; for chromium and copper the variation is small; (4) for equal conductivity, Π depends on the current density and the nature of the salts present; (5) increase in current density, which diminishes Π for all the metals studied, except cadmium, has little effect on the current efficiency for copper and nickel, and diminishes it for all the others, except chromium, for which the efficiency is increased.

—J. H. W.

The Production of Non-Adhesive Deposits. E. A. Ollard (*Met. Ind. (Lond.)*, 1935, 47, 519–521).—The processes which exist for electrodepositing metals in a form which can be readily stripped are tabulated and examined.—J. H. W.

VII.—ELECTROMETALLURGY AND ELECTROCHEMISTRY

(Other than Electrodeposition.)

(Continued from pp. 13–14.)

***The Antimony Electrode.**—II. A. Holmquist (*Svensk Kem. Tids.*, 1935, 47, 102–112; *Brit. Chem. Abs.*, 1935, [A], 826).—Cf. *Met. Abs.*, 1934, 1, 432. Measurements in air-free solution show that the potential varies with $[Sb^{III}]$ according to the Nernst formula. In hydrochloric acid solutions more concentrated than about 0.05*N* the solid phase Sb_2O_3 changes to $Sb_4O_5Cl_2$, as shown by both solubility and e.m.f. determinations. The behaviour in citrate buffers is complicated by the formation of an antimony citrate complex. The effect of oxygen in making the potential more positive appears to be connected with the formation of hydrogen peroxide. Hydrogen peroxide is decomposed by antimony powder, the velocity varying with p_{H_2} .—S. G.

IX.—ANALYSIS

(Continued from pp. 14–16.)

Tentative Method of Test for Quantitative Spectrochemical Analysis of High-Grade Pig Lead for Copper, Bismuth, Silver, and Nickel (E 25–35 T). — (*Book of A.S.T.M. Tentative Standards*, 1935, 1478–1482; and *Proc. Amer. Soc. Test. Mat.*, 1935, 35, (I)).—The method described may be applied to any high grade of Pb, provided that the impurities, namely Cu, Ag, Bi, and Ni, are not present in quantities over 0.1%. Fe is seldom found, and then it is a question whether it was originally in the sample. An arc spectrum is used, employing graphite electrodes, one of which is treated with a solution of the sample to be analyzed. Quantitative estimations are made by the comparison of the spectrum of the sample with that of standard samples of known composition.—S. G.

Tentative Method of Test for Quantitative Spectrochemical Analysis of Zinc for Lead, Iron, and Cadmium (E 26–35 T). — (*Book of A.S.T.M. Tentative Standards*, 1935, 1483–1487; and *Proc. Amer. Soc. Test. Mat.*, 1935, 35, (I)).—This method may be applied to any grade of Zn provided that the Pb, Fe, and Cd contents are less than 0.1%. An arc spectrum is used, employing graphite electrodes, one of which is treated with a solution of the sample to be analyzed. Quantitative estimations are made by the comparison

of the spectrum of the sample being analyzed with spectra of samples of known composition.—S. G.

Tentative Method of Test for Quantitative Spectrochemical Analysis of Zinc Alloy Die-Castings for Minor Constituents and Impurities (E 27-35 T).—(*Book of A.S.T.M. Tentative Standards, 1935, 1488-1494*; and *Proc. Amer. Soc. Test. Mat., 1935, 35, (1)*).—This method refers particularly to the analysis of Zn-base die-casting alloys Nos. XXI and XXIII covered by the Tentative Specification for Zinc-Base Alloy Die-Castings (B 86-34 T). The method includes the determination of Cu in alloy No. XXIII and of Mg, Fe, Pb, Sn, and Cd in alloys Nos. XXI and XXIII. The determination of Ni in an alloy differing from alloy No. XXIII by the presence of Ni as a minor constituent is also included. An arc spectrum is used, employing graphite electrodes, one of which is treated with a solution of the sample to be analyzed. Quantitative estimations are made by the comparison of the spectrum of the sample with the spectra of standard samples of known composition.—S. G.

Tentative Method for Sampling Molybdenum Salts and Compounds for Metallurgical Use (A 156-34 T).—(*Book of A.S.T.M. Tentative Standards, 1935, 263-264*; and *Proc. Amer. Soc. Test. Mat., 1935, 35, (1)*).—S. G.

***On Studies on Eliminating the Effects of PO_4 -Radical in Qualitative Analysis.**—V. Saburô Ishimaru (*Kinzoku no Kenkyu (J. Study Metals), 1935, 12, 559-563*).—[In Japanese.] Cf. *J. Inst. Metals, 1933, 53, 710*; *Met. Abs., 1934, 1, 193*. Results are given of the examination of the methods of Scheinkmann, Kreskov, and Palmieri in connection with the elimination of the PO_4 without separating it from the analytical system. Scheinkmann's method is considered to be somewhat inferior to that of Smith, though it has advantages over that of Remy. Kreskov's method is not highly recommended, while Palmieri's method may be applied with the same merit as that of Smith.—S. G.

***A New Organic Reagent for Cadmium.** Alfred W. Scott and Eleanor G. Adams (*J. Amer. Chem. Soc., 1935, 57, 2541-2542*).—Cd may be detected in the presence of much Cu by adding KI to the solution (free from NH_4^+ and SO_4^{2-}), followed by a saturated solution in 50% C_2H_5OH of 1-(2-quinoly)-4-allyl thiosemicarbazide, and then by NH_4OH ; a yellow precipitate indicates Cd. The reagent is prepared by mixing allyl isothiocyanate and 2-quinolyhydrazine in ether.—A. R. P.

Critical Studies on Organic Compounds as Analytical Reagents. IV.—Paramitrobenzeneazoresorcinol as a Reagent for Magnesium. Laird Newell, Nathan R. Pike, and Joseph B. Ficklen (*Z. anorg. Chem., 1935, 225, 281-284*).—The reagent will detect 2 p.p.m. of Mg if groups I-III of the analytical system are first removed. NH_4^+ must be kept to a minimum. In making the test the reagent is added to the slightly acid solution, followed by NH_4OH until just alkaline; a sky-blue colour or precipitate indicates Mg.—A. R. P.

***The Separation of Europium from the Other Rare Earths.** Herbert N. McCoy (*J. Amer. Chem. Soc., 1935, 57, 1756*).—Eu can be detected in mixtures of the rare earth metals by treating the concentrated chloride solution with a pinch of Zn dust and immersing a piece of litmus paper in the solution; bleaching indicates Eu. The element can be separated from the other earths by running the concentrated chloride solution through a column of amalgamated Zn into $MgSO_4$ solution, whereby all the Eu is precipitated as europous sulphate; two repetitions of the process yield a pure preparation. For quantitative determinations the reduced solution is caught in standard iodine solution and the excess I_2 titrated with thiosulphate.—A. R. P.

Quantitative Separation of Lead from Other Cations by the Chromate Method. Z. Karaoglanov and M. Michov (*Z. anal. Chem., 1935, 103, 113-119*).—Addition of $(NH_4)_2CrO_4$ to a feebly acid nitrate solution precipitates $PbCrO_4$ free from Cu, Ag, Ni, Ca, Ba, Sr, Mn, Zn, Cd, Al, and Fe^{+++} . The operation is carried out at $100^\circ C$, the precipitant being added slowly over a period of 10 minutes; the precipitate is dried at $140^\circ C$ for weighing.—A. R. P.

*Organic Flocculating Agents in the Quantitative Precipitation of Zinc Sulphide. John R. Caldwell and Harvey V. Moyer (*J. Amer. Chem. Soc.*, 1935, 57, 2372-2374).—Zn may be precipitated completely as flocculent, readily filtrable ZnS by passing H_2S through a solution containing not more than 0.25 gm. of Zn and 6-8 gm. of $(NH_4)_2SO_4$ in 250 c.c. just acid to methyl orange; coagulation is effected by addition of 5-10 c.c. of a 0.02% solution of gelatin, or a 0.06% solution of agar-agar.—A. R. P.

*A Separation of Zinc from Cobalt Based on a New Method for Reducing Post-Precipitation. John R. Caldwell and Harvey V. Moyer (*J. Amer. Chem. Soc.*, 1935, 57, 2375-2377).—The method described in the preceding paper (abstract above) effects a complete separation of Zn from Co in one precipitation provided the solution contains 0.2 c.c. of acrolein in 250 c.c. and is free from chlorides.—A. R. P.

Examination of Nickel[-Plating] Baths and Nickel Plating Salts. II.—The Quantitative Determination of Boric Acid and Citric Acid. E. Raub and H. Nann (*Mitt. Forschungsinst. Edelmetalle*, 1935, 9, 77-85).—Cf. Vincke, *Met. Abs.*, 1935, 2, 611. NaOH is recommended instead of Na_2CO_3 for removing the NH_3 before titration of the H_3BO_3 . Citric acid if present to the extent of more than 30% of the H_3BO_3 should first be destroyed by boiling with dilute H_2SO_4 and $KMnO_4$ and the Mn removed by boiling with NaOH. Citric acid is determined in a separate portion by Vincke's method.—A. R. P.

*Studies on the Elimination of the Effects of the PO_4''' Radical in Qualitative Analysis.—I.-V. Saburô Ishimaru (*Sci. Rep. Tôhoku Imp. Univ.*, 1935, [i], 24, 426-438, 439-447, 448-460, 461-472, 473-480).—[In English.] The accuracy of various methods which have been proposed for eliminating H_3PO_4 from solutions in qualitative analysis for metals was studied.—A. R. P.

Separation and Determination of Metal and Phosphate Ions in the Presence of One Another.—I.-II. Saburô Ishimaru (*Sci. Rep. Tôhoku Imp. Univ.*, 1935, [i], 24, 481-492, 493-516).—[In English.] (I.—) Mo can be determined accurately in the presence of P by treating the alkaline molybdate-phosphate solution with an acetone solution of 8-hydroxyquinoline, acidifying with $CH_3\cdot CO_2H$, boiling to expel acetone and collecting, washing, drying at $140^\circ C.$, and weighing the $MoO_2(C_9H_6ON)_2$ precipitate. The method is useful also for determining P in metals and alloys, the P being first precipitated as phosphomolybdate in HNO_3 and the washed precipitate dissolved in NH_4OH for the determination of its Mo content as above; the factor P : $12MoO_2(C_9H_6ON)_2$ is 0.006212. (II.—) Analytical procedures are given for the separation of Mg, Al, Zn, Fe, Mn, Ni, Co, Cu, Cd, Bi, Th, Ti, U, V, and W from P_2O_5 by precipitation with 8-hydroxyquinoline in tartrate solutions containing $CH_3\cdot CO_2H$, $(NH_4)_2C_2O_4$, $CH_3\cdot CONH_2$, or excess of NH_4OH .—A. R. P.

*A Note on the Determination of Antimony in White Metals. A. E. W. Smith (*J. Soc. Chem. Ind.*, 1935, 54, 372T).—The standard iodine method for titrating trivalent antimony gives good end-points when certain precautions (gentle boiling, correct acidity, and pure reagents) are observed. Iron does not interfere if less than 10% is present, but the method is useless in presence of Cu. When Cu is present, the standard permanganate titration is satisfactory; certain difficulties are discussed.—E. S. H.

Determination of Bismuth with Naphthoquinoline (Naphthine). Friedrich Hecht and Richard Reissner (*Z. anal. Chem.*, 1935, 103, 88-98).—The sulphate solution of the metal containing 3% of H_2SO_4 is treated with an excess of 2.5% naphthine sulphate solution and KI, heated to boiling, cooled, and filtered. The precipitate is dried in a current of cool, dry air and weighed as $(C_{13}H_9N)HBrI_4$ (25.98% Bi_2O_3).—A. R. P.

On the Possibility of Determining Bismuth as Basic Carbonate. Friedrich Hecht and Richard Reissner (*Z. anal. Chem.*, 1935, 102, 261-269).—Addition of a cold saturated solution of $(NH_4)_2CO_3$ to $Bi(NO_3)_3$ solution until no more precipitate, which flocculates on stirring, is formed produces complete precipita-

tion of the Bi as $(\text{BiO})_2\text{CO}_3$. The solution is heated to boiling and the precipitate collected, washed with hot water, and dried to constant weight in a stream of clean dry air.—A. R. P.

On the Determination of Bismuth with 8-Hydroxyquinoline (Oxine). Friedrich Hecht and Richard Reissner (*Z. anal. Chem.*, 1935, 102, 261-269).—Bi oxine is quantitatively precipitated by addition of a 4% solution of the reagent in 8% acetic acid to the hot nitrate solution containing NH_4 tartrate. No compound of constant composition can be obtained by adding the oxine to an acid solution containing the HBiI_4 complex.—A. R. P.

***Note on the Volumetric Determination of Manganese.** J. Leroide and A. Bruillet (*Bull. Soc. chim. France*, 1935, [v], 2, 740-742).—Mn can be determined by titrating hot neutral MnSO_4 solutions containing 20% of Na_2SO_4 with KMnO_4 (Volhard method) without addition of ZnO or acetates. The presence of much Fe^{+++} or of Cl⁻ interferes.—A. R. P.

Colorimetric Determination of Manganese in the Presence of Titanium. George J. Haigh (*Indust. and Eng. Chem. (Analyt. Edn.)*, 1935, 7, 408-409).—In the colorimetric determination of Mn as HMnO_4 , Na bismuthate or KIO_4 should be used to oxidize the Mn instead of $(\text{NH}_4)_2\text{S}_2\text{O}_8$ when Ti is present.
—A. R. P.

Bismuthate Method for Manganese.—II. Bartholow Park (*Indust. and Eng. Chem. (Analyt. Edn.)*, 1935, 7, 427).—If the oxidation to HMnO_4 is made in HNO_3 solution, the best catalyst for the arsenite titration is 0.01M-OsO₄ solution (3 drops); in H_2SO_4 solutions the same catalyst may be used but slightly more accurate results are obtained with 1 drop of 0.0025M-KIO₄ and 1 grm. of NaCl.—A. R. P.

***The Accuracy of the Titration of Thiocyanate with Mercuric Mercury.** I. M. Kolthoff and J. J. Lingane (*J. Amer. Chem. Soc.*, 1935, 57, 2377-2379).—Titration of $\text{Hg}(\text{NO}_3)_2$ solutions with KCNS is accurate to $\pm 0.05\%$.—A. R. P.

Colorimetric Determination of Molybdenum. Loren C. Hurd and Harry O. Allen (*Indust. and Eng. Chem. (Analyt. Edn.)*, 1935, 7, 396-398).—The solution should contain 5% of HCl, 0.6% of KCNS, and not less than 0.1% of SnCl_2 ; the coloured complex is best extracted with ether or cyclohexanol.—A. R. P.

***A New Method for the Indirect Volumetric Determination of Nickel.**—II. Saburō Ishimaru (*Kinzoku no Kenkyū (J. Study Metals)*, 1935, 12, 564-566).—[In Japanese.] Cf. *Met. Abs.*, 1934, 1, 194. The results obtained in the direct electrometric titration of Ni by means of dimethylglyoxime are given. Fairly reliable values were obtained when the concentration of standard $\text{K}_2\text{Cr}_2\text{O}_7$ solution is about N10 and the amount of the sample taken as Ni below 0.1 grm.; however, much higher concentration in the same solution, e.g. N5, cannot be recommended for the umpire method.—S. G.

***Potentiometric Determination of Quadrivalent Osmium with Chromous Sulphate.** William R. Crowell and Harlan L. Baumbach (*J. Amer. Chem. Soc.*, 1935, 57, 2607-2609).—Os in solution as K_2OsCl_6 obtained by distillation of OsO_4 into HCl containing SO_2 and subsequent evaporation to dryness, may be determined potentiometrically with CrSO_4 in 0.5N-HCl.—A. R. P.

***A Procedure for the Separation of the Six Platinum Metals from One Another and for Their Gravimetric Determination.** Raleigh Gilchrist and Edward Wichers (*J. Amer. Chem. Soc.*, 1935, 57, 2565-2573).—A complete scheme for the separation and determination of Os, Ru, Pt, Pd, Ir, and Rh, based on methods previously published, is put forward. The procedure consists, broadly, of the following series of operations: (1) distillation of the Os as OsO_4 by HNO_3 from an alkaline osmate solution, absorption of the OsO_4 in HCl containing SO_2 , hydrolytic precipitation of OsO_2 at $p_{\text{H}} 6$, ignition of the precipitate in H_2 to obtain Os; (2) distillation of RuO_4 from the residual solution by boiling with NaBrO_3 , followed by hydrolysis, &c., as for Os, finally weighing as Ru; (3) separation of the Ir, Rh, and Pd from Pt by

hydrolysis with NaBrO_3 first at p_{H} 6 then at p_{H} 8 in chloride solutions containing a little NaCl , double precipitation being generally necessary; (4) precipitation of the Pt in the filtrate by H_2S followed by ignition of the PtS_2 to Pt in air, the bromate being first destroyed by evaporation of the solution to dryness with HCl ; (9) dissolution of the Ir, Rh, and Pd hydroxides in HCl and precipitation of the Pd with dimethylglyoxime followed by weighing of the precipitate or ignition to Pd; (6) separation of the Rh from the Ir by double precipitation with $\text{Ti}_2(\text{SO}_4)_3$ and subsequent precipitation of both metals with H_2S after removal of the Ti with cupferron. No details are given for obtaining the metals together in one solution starting from alloys or sponges, and the disturbing effects of base metals are not considered.—A. R. P.

***Volumetric Determinations in Strongly Alkaline Solutions. III.—The Titration of Thallium and Cerium with Hypobromite.** O. Tomiček and M. Jasek (*J. Amer. Chem. Soc.*, 1935, 57, 2409–2411).—Ti⁺ can be titrated in 1.5–2M-NaOH with NaOBr by the potentiometric method without taking precautions to exclude air, provided that the solution is stirred vigorously to flocculate the $\text{Ti}(\text{OH})_3$ as it forms. Ce^{+++} can also be titrated similarly in 20–30% K_2CO_3 solution, but, in this case, air must be rigorously excluded and the greater part of the necessary NaOBr must be added in one portion.

—A. R. P.

***Determination of the Zirconium-Hafnium Ratio.** Grant Wernimont and Thomas de Vries (*J. Amer. Chem. Soc.*, 1935, 57, 2386–2387).—The increase in the optical rotation of basic tartrate solutions to which a solution of the two metals in HF has been added affords a means of determining the ratio of the metals in the mixture.—A. R. P.

X.—LABORATORY APPARATUS, INSTRUMENTS, &c.

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

(Continued from pp. 16–17.)

Measuring Eyepiece. — (*Eng. and Min. J.*, 1935, 136, 636).—Note on a direct-reading grain-size measuring eyepiece.—R. Gr.

Assay Balance. — (*Eng. and Min. J.*, 1935, 136, 636).—Describes briefly a dial-reading balance with a range of 0–20 mg., with an accuracy of 0.005 mg.—R. Gr.

XI.—PHYSICAL AND MECHANICAL TESTING, INSPECTION AND RADIOLOGY

(Continued from pp. 17–18.)

Tentative Definitions of Terms Relating to Methods of Testing (E 6–35 T). — (*Book of A.S.T.M. Tentative Standards*, 1935, 1440–1443; and *Proc. Amer. Soc. Test. Mat.*, 1935, 35, (I)).—Gives definitions of the terms "elastic limit" and "yield-strength"; these are intended to be added, when adopted, to the present Standard Definitions (E 6–30).—S. G.

New Inspection Methods in the Manufacture of Die-Castings. Rene Leonhardt (*Metal Treatment*, 1935, 1, 195–197, 201).—A brief account is given of the application of spectrographic analysis for checking the purity of raw materials; of pyrometer, density, and X-ray control in manufacture; and physical, mechanical, and corrosive tests of the finished product in the manufacture of high-quality die-castings. The composition and mechanical properties of a number of commonly used die-casting alloys are tabulated.—J. C. C.

The Mercurous Nitrate Test. H. C. Jennison (*Metals and Alloys*, 1935, 6, 348–349).—The mercurous nitrate test for internal stress cannot be used to

obtain quantitative results; long immersion in the solution will produce cracking in all copper alloys. Under certain standard conditions the test will determine only whether the stresses in the surface of the metal are less than a safe value; these conditions are a 15-minute immersion in a 10% solution of mercurous nitrate containing 13 c.c. of strong nitric acid per litre.—A. R. P.

Tentative Definitions of Terms, with Units and Symbols, Relating to Magnetic Testing (A 127-35 T). — (*Book of A.S.T.M. Tentative Standards, 1935, 265-270*; and *Proc. Amer. Soc. Test. Mat., 1935, 35, (I)*).—These are in effect a tentative revision of, and are intended to replace when adopted, the present Standard Definitions (A 127-34).—S. G.

Tentative Methods of Verification of Testing Machines (E 4-35 T). — (*Book of A.S.T.M. Tentative Standards, 1935, 1427-1438*; and *Proc. Amer. Soc. Test. Mat., 1935, 35, (I)*).—S. G.

Tentative Method of Test for Long-Time (Creep) High-Temperature Tension Tests of Metallic Materials (E 22-35 T). — (*Book of A.S.T.M. Tentative Standards, 1935, 1415-1426*; and *Proc. Amer. Soc. Test. Mat., 1935, 35, (I)*).—Covers long-time (creep) high-temperature tension tests of metals within the range room temperature to 2000° F. (1093° C.).—S. G.

Tentative Method of Test for Linear Expansion of Metals (B 95-35 T). — (*Book of A.S.T.M. Tentative Standards, 1935, 396-406*; and *Proc. Amer. Soc. Test. Mat., 1935, 35, (I)*).—This method is intended especially for determining the expansion of oxidation-resistant alloys at temperatures up to 1000° C. An appendix describes the dilatometer, tube and gauge carrier, general assembly of the expansion test apparatus, and assembly for use with the microscope.—S. G.

***On the Untenability of the Concept of Upper and Lower Yield-Point and Breaking Strength of Mild Steel and Other Metals.** G. Welter (*Metallwirtschaft, 1935, 14, 1043-1047*; and (translation) *Metallurgia, 1936, 13, 89-92*).—Attention is directed to the fact that in tensile tests the magnitudes of the decrease in load after passing the yield-point and between the maximum load and the breaking load depend on the construction of the machine. From these facts the false conclusion is reached that the observed decreases are fictitious and are caused solely by the construction of the machine.—v. G.

A Bend Tester for Vacuum Tube Wires. W. J. Farmer (*Bell Lab. Record, 1935, 14, 139-142*).—Describes and illustrates an impact bend tester, designed for measuring the stiffness of nickel wires from 0.003 to 0.125 in. in diameter. The angle through which the wire is bent when it is struck by a pendulum released from a given height is recorded.—J. C. C.

Modern Method of Hardness Testing in the Workshop. Karl Frank (*Werkstatt u. Betrieb, 1936, 69, (1/2), 11-14*).—The hardness testing machine described may be used for Rockwell, Brinell, or Vickers tests. The difficulty of correctly aligning the specimen under works' conditions is obviated by the provision of alternative platens for very large, very hard, or lamellar specimens. Brinell hardness figures for different diameters of ball and loads in kg. are correlated in a table.—P. M. C. R.

Tentative Specifications for Round-Hole Screens for Testing Purposes (E 17-35 T). — (*Book of A.S.T.M. Tentative Standards, 1935, 1364-1365*; and *Proc. Amer. Soc. Test. Mat., 1935, 35, (I)*).—These are in effect a tentative revision of, and are intended to replace when adopted, the present Standard Specifications (E 17-33).—S. G.

***Dynamic Elasticity of Metals.** A. Leblanc (*Métaux, 1935, 10, 209-213*).—The dynamic elasticity of a metal is defined as the elastic deformation produced in the metal by a series of dynamic stresses, or the capability of the metal to absorb work due to shock. An important ratio is that of the dynamic elasticity to the density. The higher the elastic limit of a metal and the lower the coeff. of elasticity, the more important is its dynamic elasticity and the higher will be its resistance to shock. This is discussed mathematically,

and the variation of this property with the temperature of annealing after quenching in the case of Duralumin- and Almasilium-type alloys is shown graphically.—J. H. W.

XII.—TEMPERATURE MEASUREMENT AND CONTROL

Recent Developments in Platinum Thermocouples. Bert Brenner (*Indust. and Eng. Chem. (Analyt. Edn.)*, 1935, 7, 438–440).—For use in making thermocouples the purest metals are essential: the best test of purity is the ratio of the electrical resistances (R) at 0° and 100° C., the values of $(R_{100} - R_0)/100R_0$ for pure platinum being 0.00392 and for pure rhodium 0.00434. Both the pure platinum and the rhodium-platinum alloy should be melted on pure lime with a strongly oxidizing oxy-hydrogen flame, cast into ingots, forged, rolled, swaged, and finally drawn through diamond dies. Variations in the diameter of the usual 0.5 mm. wires must be less than 0.005 mm., the difference in e.m.f. between every 4 metres less than 3 microvolts at 1200° C., and the variations in the readings of the couple at 1200° C. not more than $\pm 1^\circ$ C. The resistance to contamination in service is greatly affected by the temperature, time, and number of anneals, the sensitivity of platinum to contamination after annealing for 3 minutes at 1500° C. being ten times as great as that of the rhodium alloy due to the formation of large crystals, open grain boundaries, and severe pitting. For platinum the best annealing conditions are electric heating for 3 minutes at 600° C. (7 amp.) and for the rhodium alloy 2 minutes at 1200° C. (11 amp.). On subsequently annealing at 1500° C. for 6 hrs. the e.m.f. against the normalized wire should not exceed 5 microvolts at 1200° C. The tensile properties of both wires after various anneals are tabulated.

—A. R. P.

Thermocouples. W. Pratt (*Trans. N.E. Coast Inst. Eng. Ship.*, 1934–1935, 51, 103–118).—Thermo-electric currents in general are first considered, and it is indicated how the thermo-electric properties of all metals are shown on the thermo-electric diagram. The laws of thermo-electric effects are discussed and also the approximate equations to the e.m.f.–temperature difference curves. Typical arrangements of thermocouples for temperature measurement purposes are referred to, and the methods of measuring temperatures compared with special reference to cold-junction regulation and the constancy of thermocouples. Special data are given for a platinum/platinum-rhodium thermocouple and for two base-metal thermocouples.—J. W. D.

***Heat Capacities and Entropies of Organic Compounds. I.—A Thermodynamic Temperature Scale in Terms of the Copper-Constantan Thermocouple from 12° to 273° K.** J. G. Aston, Eugene Willihnganz, and George H. Messerly (*J. Amer. Chem. Soc.*, 1935, 57, 1642–1646).—The copper-Constantan couple has been standardized against the helium gas thermometer at temperatures below 0° C., and an e.m.f. table is given for temperatures between -261° and -183° C. and compared with the Leiden scale based on hydrogen and oxygen vapour-pressure thermometers. The results agree within $\pm 0.03^\circ$ C.

—A. R. P.

***Thermocouples from 2° to 90° Absolute.** J. Elston Ahlberg and Walter O. Lundberg (*J. Amer. Chem. Soc.*, 1935, 57, 2722–2723).—Experiments with copper-Constantan couples show that at 13° – 90° abs. the e.m.f. in microvolts (E) is related to the temperature (T) by the expression: $E = A + BT^2 + CT^3 + DT^4$, where A , B , C , and D are constants equal, respectively, to 6039.9, -1.5475×10^{-1} , 6.2064×10^{-4} , and -1.5652×10^{-6} .—A. R. P.

XIII.—FOUNDRY PRACTICE AND APPLIANCES

(Continued from pp. 18-19.)

Sulphur Absorption in Metal Melting. E. J. Bullen (*Met. Ind. (Lond.)*, 1935, 47, 540).—A letter. Experiments have shown that in melting nickel-bronzes, containing tin 10-13 and nickel 0.5-1.5%, in Salamander pots, there is no perceptible difference in the sulphur absorption or the physical properties of the alloy whether a coke furnace or an oil furnace is used. In the tests, oil containing 2.85% sulphur (much in excess of the normal 1-1.5%) was used in the oil furnace.—J. H. W.

The Castability of Aluminium Alloys. A. von Zeerleder (*Met. Ind. (Lond.)*, 1935, 47, 531-534, 540).—The methods for investigating the castability of alloys from 1898 to the present time are reviewed, and modern apparatus and methods of investigation (cf. Portevin and Courty) are described. The use of the spiral mould is exemplified in the case of a number of aluminium alloys, particularly Anticorodal. In the case of the aluminium-magnesium alloys, the castability decreases when the solidification range decreases, while for numerous other alloys it decreases when the solidification range increases. 11 references are given.—J. H. W.

Recommended Practice for Sand-Cast Aluminium Alloys. Non-Ferrous Division Committee on Recommended Practices (*Trans. Amer. Found. Assoc.*, 1935, 43, 1-26; and *Found. Trade J.*, 1935, 53, 454-455, 471-473).—A good moulding sand for aluminium alloys has a compressive strength of 5-9 lb./in.², a permeability of 4-8, a clay content of 20-35, and a fineness number of 175-250. Gates, risers, and feeders must be so placed that the metal flows evenly into thick and thin sections and no pressure is exerted on portions of the casting by shrinkage during solidification. Care should be taken to avoid entry of dross into the mould and to keep agitation to a minimum during pouring so as to avoid inclusions of oxide skins. Cores should be soft to offer the minimum resistance to contraction of the solidifying metal. Cast-iron melting pots are satisfactory provided they are coated with whiting each day before use and scraped every evening; graphite or carborundum pots are best for alloys containing silicon and magnesium, since introduction of iron into these alloys has a detrimental effect on the mechanical properties and corrosion-resistance. Melting, holding, and casting temperatures should be kept as low as possible to prevent gas absorption, oxidation, and coarse grain growth during solidification. Recommended casting practice for numerous aluminium alloys is given together with tabulated specifications for composition and mechanical properties.—A. R. P.

The Deoxidation of Copper Melts with Beryllium. R. Marker (*Metall-Woche*, 1935, 237-238).—The use of 0.005-0.02% of beryllium, added as a 10% beryllium-copper alloy, for the deoxidation of copper is recommended. By suitable adjustment of the quantity of deoxidizer used very high conductivity values can be obtained combined with freedom from porosity in castings.—A. R. P.

Large Centrifugal Castings. — (*Met. Ind. (Lond.)*, 1935, 47, 585).—Bronze tubes up to 44 in. diameter, 30 ft. long, and 50,000 lb. in weight are cast in horizontal water-cooled casting machines. The melting equipment consists of oscillating oil-fired furnaces of 13,000 lb. capacity, fitted with high- and low-pressure blowers, top pour ladles being used for small castings and bottom pour for large ones.—J. H. W.

Die-Casting. A. H. Munday (*Found. Trade J.*, 1935, 53, 383-386; discussion, 386; and *Machinery (Lond.)*, 1935, 47, 277-281, 352-353).—Summary of a paper read before the Lancashire Branch of the Institute of British Foundrymen. The methods of type, slush, Corthias, gravity, and pressure die-casting

are briefly described, and the alloys used commercially for these methods are discussed. The Doehler, goose-neck, and Polak machines are described, and the importance of die design is pointed out. In the discussion, reference was made to the Soag machine, to die production, and to the difficulties of casting gun-metal and yellow-brass.—J. H. W.

Principles of Present Die Design. Technique for Various Die-Casting Alloys. E. Stevan (*Met. Ind. (Lond.)*, 1935, 47, 579–582).—A discussion of the factors to be considered in die design, standard types of die, material for die construction, methods of parting moulds, differences of treatment, and the removal of cores.—J. H. W.

The Expansion and Contraction of Moulding Sand at Elevated Temperatures. H. W. Dietert and F. Valtier (*Trans. Amer. Found. Assoc.*, 1935, 43, 107–122; discussion, 122–124).—Expansion of moulding sand is reduced by increasing the grain-size, reducing the proportion of fines, adding combustible materials (e.g. sea-coal), reducing the hardness of the mould, increasing the permeability, and reducing the moisture content. Opposing stresses between expansion and contraction are reduced by reducing the clay content and by all of the factors which reduce expansion, except addition of combustible materials. After heating the sand above 1300° C. the expansion is reduced by 50%. The use of sands with unsuitable expansion and contraction properties often gives rise to such defects as “scabs” and “rat-tails.” Apparatus for testing the expansion and contraction of moulding sands is described, and methods of controlling these properties are discussed.—A. R. P.

Continuous Production in the Foundry. — (*Aluminium and Non-Ferrous Rev.*, 1935, 1, 42–44).—The use of conveyor systems in aluminium foundries is discussed generally.—J. C. C.

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

†**The Economy of Old Metals, Especially Copper, Lead, Zinc, and Tin.** W. R. Ingalls (*Min. and Met. Soc. Amer., Bull. No. 235*, 1935, 75–95; and *Amer. Metal Market*, 1935, 42, (218), 2; (219), 3, 4; (220), 2; (221), 3, 6).—Great reserves of secondary metals do not exist, the normal supply of this material, other than that of precious metals, being that which accrues from scrapping obsolete plant or stripping useful plant. The cycle of production, distribution, consumption, and “reflux” of lead, tin, zinc, and especially copper is traced out, and that of aluminium, gold and silver, iron and steel is indicated, and some general observations on the subject are put forward.—J. H. W.

The Attractiveness and Importance of Secondary Metals. F. H. Brownell (*Min. and Met. Soc. Amer., Bull. No. 235*, 1935, 95–100).—Discusses the reasons why large primary metal companies in the U.S.A. deal with secondary metals, and the effect this has on the production of virgin metal.—J. H. W.

The Influence Wielded by Scrap Copper. Benno Elkan (*Min. and Met. Soc. Amer., Bull. No. 235*, 1935, 100–101; discussion, 101–102).—The history of the commercial refining of copper in the U.S.A. is briefly outlined, and a plea is made for common sense in the policy of production and marketing.—J. H. W.

Reclaiming Metals from Slag. — (*Eng. and Min. J.*, 1935, 136, 600).—A note stating that it was found that 35–72% of the different precious metals contained in a refining slag, settled in the crust which solidifies on the surface of the pot in about 6 minutes after the pot is filled. Slag is now bled after the crust has formed and the two portions separately treated.—R. Gr.

XV.—FURNACES AND FUELS

(Continued from p. 19.)

Electric Furnace Successful in Precious Metal Melting. S. Bennis (*Edison Elect. Inst. Bull.*, 1935, 3, (4), 125).—A small electric furnace with Globar heating elements and $10 \times 7 \times 7$ in. heating chamber is described. The working temperature is 700° – 1500° C., and the capacity sufficient for 100 oz. of gold alloy: the approximate melting time is 15 minutes, whilst the furnace can be heated from room temperature to about 1350° C. in 30 minutes. A special regulator limits the power input to a safe value.—P. M. C. R.

Electric Heat Furnaces. George H. Hall (*Elect. World*, 1935, 105, 2104–2106).—A brief review of the construction of the principal types of electric heat-treatment furnaces.—J. C. C.

Controlled Atmospheres in Electric Furnaces. George H. Hall (*Elect. World*, 1935, 105, 2205–2207).—Includes an illustrated description of the construction of bell-type bright-annealing furnaces. Reference is made to electric brazing, and a comparison is given of the relative costs of various gases used in controlled-atmosphere furnaces.—J. C. C.

Small Electric Resistance Furnaces. E. Schmidt (*A.E.G. Mitt.*, 1935, (11), 351–352).—Illustrated descriptions are given of a small hardening furnace working at 1350° C., with brine quenching bath; an annealing furnace operating at 950° C.; electrically-heated melting crucibles for lead and tin; a drying furnace; and an electrically-warmed brine bath.—P. M. C. R.

Rod-Shaped Heating Elements for Heavy Duty. H. Bachmann (*A.E.G. Mitt.*, 1935, (8), 274–276).—The element described consists of a heating coil embedded in a packing material which conducts heat well; this is enclosed in a tube, which is coated with steel, brass, nickel silver, or is Alumetized or nickel-plated. A graphical record of the life of different types of envelope plotted against working temperature shows the superiority of the Alumetized type. The nature and purity of the packing material and the taper of the rod on which the heating coil is carried are of great importance.—P. M. C. R.

Pulverized-Fuel Firing Without a Pulverizer. Advantages Derived from Bulk Supply. H. D. Tollemache (*Iron Coal Trades Rev.*, 1936, 132, 103–104, 105).—The main objection to the use of pulverized coal in metallurgical works has been overcome, since it can now be obtained in ready pulverized form without the necessity to instal a pulverizing plant. The cost of converting furnaces and of maintenance are discussed, comparative figures being given for electricity, gas, oil, and pulverized coal. Methods of production and transport are described and the qualities desirable in a good-class pulverized fuel are discussed.—L. A. O.

***The Resistance to Flow of Gases Through Masses of Heaped Granular Material.** E. Diepschlag (*Feuerungstechnik*, 1935, 23, 133–136).—An experimental investigation relating to the resistance offered to the passage of air through columns of packed spheres of respective diameters 3, 2, and 1.32 mm. and through angular grains of quartz is reported. A formula summarizing the results is given.—J. S. G. T.

Unburnt Carbon, Considered from the Point of View of the Determination of Excess Air Factor. M. S. Maslenikoff (*Feuerungstechnik*, 1936, 24, 7–9).—The significance of the excess air factor in the discussion of the completeness or otherwise of the combustion of solid fuels is discussed.—J. S. G. T.

†**The Tasks and Purpose of Combustion Technique.** Wilhelm Gumz (*Feuerungstechnik*, 1936, 24, 1–3).—The purpose and tasks of combustion control are briefly reviewed.—J. S. G. T.

Tentative Specifications for Classification of Coals by Rank (D 388–35 T). — (*Book of A.S.T.M. Tentative Standards*, 1935, 617–623; and *Proc. Amer.*

Soc. Test. Mat., 1935, 35, (I)).—The basic scheme of classification is according to fixed carbon content and calorific value (expressed in B.t.u.) calculated to the mineral-matter-free basis. The higher rank coals are classified according to fixed carbon on the dry basis, and the lower rank coals according to B.t.u. on the moist basis. Agglutinating and slacking indices are used to differentiate between certain adjacent groups.—S. G.

Tentative Definitions of the Terms Gross Calorific Value and Net Calorific Value of Fuels (D 407-35 T). — (*Book of A.S.T.M. Tentative Standards*, 1935, 640; and *Proc. Amer. Soc. Test. Mat.*, 1935, 35, (I)).—S. G.

XVI.—REFRACTORIES AND FURNACE MATERIALS

(Continued from pp. 19-20.)

Some Uses of Insulating Fire-Brick in Modern Foundry Practice. C. L. Norton, Jr. (*Trans. Amer. Found. Assoc.*, 1935, 43, 54-58; discussion, 59-74).—Modern light-weight insulating bricks when properly faced with heavy non-porous bricks or refractory cement effect considerable heat economics in the melting of non-ferrous metals. Thus in a properly constructed gas-fired furnace for melting brass gas consumption was only 3 ft.³ per lb. of metal, and the reduction in zinc losses over those experienced in a furnace lined with heavy refractories was sufficient to pay the whole fuel bill. Owing to the more rapid melting of the charge the zinc content could be more effectively controlled so that the metal was more ductile and there were fewer rejects; in addition tool and die costs were materially reduced due to the better grade of alloy produced.—A. R. P.

The Chilling of Refractories: Method for the Simultaneous Determination of Stability under Temperature Changes and Resistance to Corrosion. Adolf Möser (*Feuerungstechnik*, 1936, 24, 9-10).—An experimental method based on passage of water through the mass is described.—J. S. G. T.

Tentative Definitions of Terms Relating to Refractories (C 71-35 T). — (*Book of A.S.T.M. Tentative Standards*, 1935, 555; and *Proc. Amer. Soc. Test. Mat.*, 1935, 35, (I)).—Gives definitions of 6 terms; these are intended to be added when adopted to the present Standard Definitions (C 71-35).—S. G.

Tentative Revision of Standard Definitions for Fireclay Refractories (C 27-35). — (*Book of A.S.T.M. Tentative Standards*, 1935, 1522; and *Proc. Amer. Soc. Test. Mat.*, 1935, 35, (I)).—A definition of "Super Duty Fireclay Brick" is added.—S. G.

XVII.—HEAT-TREATMENT

(Continued from p. 20.)

***The Effect of Annealing on the Release of Internal Stress in Cold-Drawn Rods.** Kisuke Saito (*Kinzoku no Kenkyu (J. Study Metals)*, 1935, 12, 551-558).—[In Japanese.] The effects of annealing on the release of internal stress and the change in hardness in cold-drawn rods was studied for seven materials: copper, brasses (70 : 30 and 60 : 40), Armeo iron and steels containing 0.3, 0.8, and 1.3% carbon. The release of internal stress was inferred from the change of length of the rod, measured in the direction of drawing at room temperature, to which the specimen was cooled slowly in the furnace after annealing at different temperatures for $\frac{1}{2}$ hr. The annealing was repeated at successively higher temperatures. In general, the length of the rod decreases in the cases of copper and the brasses in the whole range of annealing temperatures, but in the cases of iron and steels it increases in a certain range of temperature, and

afterwards decreases. The temperatures at which internal stress is released are about 300° C. for copper, 370° C. for brasses, and 650° C. for iron and steels, and the increased hardness due to cold-working is reduced to its original value in the vicinity of these temperatures.—S. G.

The Bright-Annealing of Silver in Gas Furnaces. P. Hopkinson (*Met. Ind. (Lond.)*, 1935, 47, 614).—A brief description is given of a continuous type of gas-fired furnace, having no muffle or special form of atmosphere, and producing thoroughly annealed and perfectly bright silver, free from "fire."

—J. H. W.

XVIII.—WORKING

(Continued from p. 20.)

Metallurgical Control in the Production of Non-Ferrous Sheet and Strip. A. F. Dunbar (*Met. Ind. (Lond.)*, 1935, 47, 603–607, 630–632).—Read before the Melbourne University Metallurgical Society. A description is given of the foundry and rolling-mill practice of the Ammunition Factory of the Munitions Supply Board, Australia, with particular reference to the laboratory control of the quality of the finished product.—J. H. W.

Three-Phase Regulating Drives in Rolling Mills. — (*A.F.G. Progress*, 1935, (2), 26–28).—The advantages and disadvantages of the Krämer, Scherbius, and 3-phase commutator cascade regulating systems are compared: the circuit diagram is reproduced in each case.—P. M. C. R.

Brass and Copper Forgings, Their Manufacture, Properties, and Uses. Edwin F. Cone (*Metals and Alloys*, 1935, 6, 337–341).—Brass for forging should have the composition: copper 58.5–61.5, lead 1.5–2.5, total impurities less than 0.5%, zinc remainder. Forging tools and manual and mechanical methods of forging are briefly described and some characteristic microstructures of forgings are reproduced. Surface stresses induced by forging may be relieved by annealing for 30 minutes at 315°–425° C. prior to pickling and plating.

—A. R. P.

Some Metallurgical Aspects of the Radio Tube Industry. Stanton Umbreit (*Metals and Alloys*, 1935, 6, 273–277, 279).—Modern methods of manufacturing the various parts of radio valves are described, with especial reference to the preparation and drawing of filaments of tungsten, platinum, or nickel coated with thorium, caesium, or barium compounds, the production of carbon-coated anodes, and the construction of molybdenum wire grids. The use of magnesium and barium as "getters" is also discussed.—A. R. P.

The Machining of Automobile Pistons with Diamond Tools. C. A. Birkebak (*Machine moderne*, 1935, 29, 615–616).—Light-alloy pistons of 12–43 mm. diameter are machined by this method. Full details regarding preliminary and final machining include cutting speeds, feed, and average production. The machine employed is described and illustrated.—P. M. C. R.

The Machining of Light Alloys. — (*Machine moderne*, 1935, 29, 549–554).—A rough classification of the principal types of light alloy includes their approximate compositions. The special properties of each class with regard to drilling, cutting, grinding, and turning are discussed and compared graphically, and characteristic types of turning are illustrated. The design of appropriate drills is discussed.—P. M. C. R.

XX.—JOINING

(Continued from p. 21.)

Soft Solders. A. H. Falk (*Bell Lab. Record*, 1935, 14, 89–93).—Rosin should be used as a flux for electrical work, where corrosion must be guarded against. If a more active flux is essential, ammonium and zinc chlorides may

be used, but only if followed by a citrate or cyanide wash; alternatively, naphthalene tetrachloride, followed by an alcohol wash, is advised. Recommendations are tabulated for solder compositions, fluxes, and neutralizing agents for typical soldering jobs. Lead-tin solders with 45 or 33% tin are recommended for general use. The higher working temperatures and wider solidification ranges of the lower-tin solders may retard the rate of working, but more efficient soldering irons to counteract this are being developed.

—J. C. C.

Resistance Welding of Light or Special Metals and Alloys. R. Salleles (*Rev. Soudure autogène*, 1935, 27, (260), 2-7; and (summary) *Met. Ind. (Lond.)*, 1935, 47, 489-493).—The Sciaky system is described, in which a pressure cycle is synchronized with the current timing, the contact pressure being high just before the making of the weld in order to make good contact; being reduced during the passage of the current, in order to increase the resistance of the interface; and, finally, being increased again to give a forging action. The "accumulation of energy" system is also described, in which electromagnetic induction is used, the primary circuit being fed by d.c. The secondary circuit is shorted to make the weld, the primary being cut simultaneously, so that the built-up energy is used to make the weld. The advantages of the system are said to be the reduced and more uniform load on the supply main, the possibility of using extremely short welding times, and the very high accuracy of control of both time and current. Many examples of spot-welded members in stainless steel and Duralumin are illustrated and described.—H. W. G. H.

Copper Welding. — (*Indoxco*, 1936, 1, (3), 21-22).—A general description of copper welding.—W. E. B.

The Autogenous Welding of Copper and Its Alloys. — (*Illust. Zeit. Blechindustrie*, 1935, 64, 1412-1415, 1442-1443, 1473-1475).—Directions are given for the welding of copper wire and sheet, and Bengough's table connecting welding temperature and tensile properties is quoted. Suitable fluxes and welding wire are recommended, and the structures and mechanical properties of welds thus produced are illustrated. Similar directions are given for brass, bronze, Neusilber, and Monel metal.—P. M. C. R.

***Thermal Study of Welds.** A. Portevin and D. Sférian (*Chaleur et Industrie*, 1935, 16, 409-424).—A theoretical study has been made of the temperature distribution which occurs in a long bar and an infinite plate after a given zone is raised rapidly to the temperature of fusion. Experimental verification of the results has been obtained by observing temperature changes after welding by means of platinum/platinum-rhodium thermocouples 0.2 mm. in diameter fixed both on the surface and in the interior of the samples. Tests were carried out on samples of mild steel, austenitic nickel-chromium steel, copper, and aluminium welded by oxy-acetylene in several different conditions, and on electric arc-welded steel samples. From the results, "thermal surfaces," showing the thermal distribution after welding, have been constructed. Arc-welding results in steeper temperature gradients and more rapid cooling rates than oxy-acetylene welding. The calorific properties of the metal, the temperature of preheating, and the size and shape of the pieces welded are among the principal factors influencing the temperature distribution.—J. C.

***Some Residual Stress Effects in Static Tension Specimens.** R. E. Jamieson (*J. Amer. Weld. Soc.*, 1935, 14, (9), 16-21).—M.S. plates $4\frac{3}{4}$ in. \times $\frac{5}{8}$ in. \times 5 ft. long were grooved on their longer edges, the grooves being filled with weld metal by arc-welding, and the plates then tested in tension. Two pairs of extensometers were fixed on lines at 1 in. from each edge of the plate, and the load-deformation curves are given, being compared with a curve obtained from an unwelded plate. The average ultimate stress of the welded plates was about 9% less than that of the unwelded plate, and the elongations were

of the order of 12 and 33%, respectively. The curves of the welded plates showed a deviation, practically from the beginning of loading, from the standard curve, there being a larger average deformation for a given applied average stress. The welding appeared to raise the yield-point and decrease the ductility of the plates.—H. W. G. H.

A New General-Purpose Meter for Resistance Welding. C. Stansbury (*J. Amer. Weld. Soc.*, 1935, 14, (9), 32–35).—A meter is described by which the primary and secondary welding currents, the welding voltage, and the duration of the weld may be measured. The instrument uses neon glow tubes and is based on the facts that these have a definite critical voltage which must be exceeded before a glow discharge will start, and that a discharge for a period as short as one cycle can readily be seen. The primary welding current is measured directly, the secondary by means of an air-core current transformer, and the time by charging a condenser through a calibrated rheostat which is adjusted so that the voltage across the condenser just reaches the critical value which will cause a glow in the neon tube at the instant that the weld is terminated.—H. W. G. H.

Control of Spot- and Seam-Welding Machines Operating on the Grid System. C. Fröhmer (*A.E.G. Mitt.*, 1935, (10), 321–325).—A suitable system for securing rapid and accurate control of the welding current is described: circuit diagrams are given for the welding of light alloys and for stainless steel.—P. M. C. R.

New Transformer for Arc-Welding with Alternating Current. R. Hofmann (*A.E.G. Mitt.*, 1935, (12), 399–401).—The transformer described is available for ordinary and for especially heavy welding. Full working details are tabulated for three ordinary supply voltages and for various welding currents, and efficiency and power-factor diagrams are given for both light and heavy types for two types of electrode.—P. M. C. R.

British Standard Specification for Carbide of Calcium (Graded Sizes). — (*Brit. Stand. Inst. No. 642*, 1935, 20 pp.).—S. G.

XXI.—INDUSTRIAL USES AND APPLICATIONS

(Continued from pp. 21–23.)

The Use of Aluminium in the Manufacture of Acids. — (*Illust. Zeit. Blechindustrie*, 1935, 64, 1380–1381, 1410–1411).—The results of investigations by various groups of workers on the resistance of aluminium to various acids, under various conditions of temperature and concentration, are summarized. The materials considered are formic, acetic, oleic, palmitic, stearic, lactic, oxalic, benzoic, carbolic, boric, hydrofluoric, hydrochloric, nitric, sulphuric, sulphurous and citric acids, and acetone: where effective protection is practicable a method is indicated.—P. M. C. R.

Reflecting Surfaces of Aluminium. J. D. Edwards (*J. Soc. Motion Picture Eng.*, 1935, 24, 126–132; *Phot. Abs.*, 1935, 15, 98).—It is shown that aluminium is inherently a good reflector of ultra-violet, visible and infra-red radiations, and means are described for developing and maintaining high reflection efficiency. The Alzak process of electrolytic brightening is described; with this process specular and diffuse aluminium surfaces can be made having reflection factors of about 85%. The Alzak reflectors have a hard surface of transparent aluminium oxide, and are consequently weather-resisting and easily cleaned.—S. G.

Light Metal Bobbins. — (*Spinner und Weber*, 1935, 53, (37), 8–9; *J. Textile Inst.*, 1935, 26, 557A).—The disadvantages of ordinary paper, wood, Bakelite, and metal bobbins and tubes are discussed and the advantages of hard light metal bobbins are pointed out. Hard light metal is harder than paper board and the walls can be made very thin so that the bobbins are lighter in weight

than paper bobbins. The process of construction can be controlled accurately, so that there are no variations in dimensions, and light metal bobbins have a life duration about 35 times that of the paper board variety. Bobbins made from hard light metal are not affected by wet treatments as in steaming and dyeing, and are resistant to attack by acids. The grip of these bobbins on spindles can be improved by the use of an intermediate layer of rubber.

—S. G.

New "Compound Casting" Process for the Manufacture of Pistons, Especially of the "Fire-Proof" Type. G. Gressenich (*Automobiltech. Z.*, 1935, 38, 623-625).—The unequal distribution of heat in an automobile piston is illustrated by a graph, and the advisability of combining alloys of different wearing properties and thermal conductivity is emphasized. A description is given of a piston in which the body consists of "EC 24" (a hard aluminium-silicon alloy) and the centre of the head of "Y" alloy. A photomicrograph of the transition zone is reproduced.—P. M. C. R.

Cast Materials: A Guide to the Machine Constructor and Works' Engineer (Light Alloys). Albert Achenbach (*Werkstatt u. Betrieb*, 1936, 69, 9-10).—This review of the engineering and constructional applications of the principal light alloys includes brief accounts of the composition and properties of the copper-aluminium group, "Y" alloy, Hydronalium, K.S.-Seewasser, Silumin, Kupfer-Silumin and its derivatives, and Elektron.—P. M. C. R.

Increased Activity in Old and New Consuming Fields Gives Bright Outlook for Aluminium. George J. Stanley (*Amer. Metal Market*, 1936, 43, (2), 1, 6).—A brief review of the uses of aluminium.—L. A. O.

British Aluminium Company Limited Intelligence Memorandum [Aluminium Specifications]. — (*Light Metals Research*, 1935, 4, (12), 5 pp.).—A bibliography of the British Standard Specifications, British Standard Specifications for Aircraft Materials, and Air Ministry Material Specifications which are of direct interest to the aluminium industry.—J. C. C.

Aluminium Alloy Sand- or Die-Castings. — (*(Brit.) Air Min. Specification No. D.T.D. 269*, 1935, 3 pp.).—Covers the material generally known as NA 222 alloy.—S. G.

Aluminium-Silicon Alloy Sand- or Die-Castings (Not Suitable for Pistons). — (*(Brit.) Air Min. Specification No. D.T.D. 272*, 1935, 3 pp.).—Covers the material generally known as NA 125/W. 60 alloy.—S. G.

Aluminium-Silicon Alloy Sand- or Die-Castings (Not Suitable for Pistons). — (*(Brit.) Air Min. Specification No. D.T.D. 276*, 1935, 3 pp.).—Covers the material generally known as NA 125/T. 67 alloy.—S. G.

Aluminium Alloy Sheets and Strips. — (*(Brit.) Air Min. Specification No. D.T.D. 270*, 1935, 5 pp.).—Covers the material generally known as NA 24 S alloy (sp. gr. \approx 2.85).—S. G.

Aluminium Alloy Bars (Extruded or Rolled) and Extruded Sections. — (*(Brit.) Air Min. Specification No. D.T.D. 280*, 1935, 4 pp.).—Covers the materials generally known as NA 24 S alloy, Duralumin G, and Hiduminium 72 (sp. gr. \approx 2.80) for bars up to 4 in. diam. or width across flats and extruded sections up to 3 in. in thickness.—S. G.

Aluminium Powder as a Metal Finish. — (*Aluminium and Non-Ferrous Rev.*, 1935, 1, 19-20).—J. C. C.

Aluminium Packing in the Canning Industry. — (*Aluminium and Non-Ferrous Rev.*, 1935, 1, 17-18).—Aluminium packing is particularly suitable for herrings in oil. In 1934-1935, 8 million boxes were packed in Norway.

—J. C. C.

Modern Practice in Heat Insulation. C. Ellis (*Eng. Rev.*, 1935, 49, 170-176, 354).—Aluminium foil, and other non-metallic materials are described, and their special applications are indicated. A table shows their approximate working temperature ranges.—P. M. C. R.

Tentative Specifications for Aluminium-Manganese Alloy Sheet and Plate (B 79-34 T). — (*Book of A.S.T.M. Tentative Standards*, 1935, 293-297; and *Proc. Amer. Soc. Test. Mat.*, 1935, 35, (I)).—A revision of the tentative specification re-issued in 1933. Commercial flat sheet is to be supplied on orders for sheet, except where coiled or strip sheet is specifically ordered. Requirements for chemical composition are: aluminium (minimum) 97.0, manganese 1.0-1.5, and copper (maximum) 0.2%.—S. G.

Tentative Revision of Standard Specifications for Copper Trolley Wire (B 47-32). — (*Book of A.S.T.M. Tentative Standards*, 1935, 1517; and *Proc. Amer. Soc. Test. Mat.*, 1935, 35, (I)).—Fig. 1 now appearing in the specifications, which shows permissible variations in the dimensional requirements of the standard sections of grooved trolley wire, is to be replaced by Fig. 1 as given in *Book of A.S.T.M. Tentative Standards*, 1935, 341.—S. G.

Tentative Specifications for Bare, Stranded Copper Cable: Hard, Medium-Hard, or Soft (B 8-35 T). — (*Book of A.S.T.M. Tentative Standards*, 1935, 330-333; and *Proc. Amer. Soc. Test. Mat.*, 1935, 35, (I)).—These are in effect a tentative revision of, and are intended to replace when adopted, the present Standard Specifications (B 8-27). They cover bare, stranded cables made from round copper wires, for general use as electrical conductors.—S. G.

Tentative Specifications for Insulated Wire and Cable: Class AO, 30 Per Cent. Hevea Rubber Compound (D 27-35 T). — (*Book of A.S.T.M. Tentative Standards*, 1935, 1135-1160; and *Proc. Amer. Soc. Test. Mat.*, 1935, 35, (I)).—Cover the conductors, insulation, cable tape, cotton braid, and lead sheaths of Class AO rubber-insulated wire and cable.—S. G.

Tentative Specifications for Insulated Wire and Cable: Class A, 30 Per Cent. Hevea Rubber Compound (D 393-34 T). — (*Book of A.S.T.M. Tentative Standards*, 1935, 1173-1174; and *Proc. Amer. Soc. Test. Mat.*, 1935, 35, (I)).—S. G.

Tentative Specifications for Insulated Wire and Cable: Performance Rubber Compound (D 353-35 T). — (*Book of A.S.T.M. Tentative Standards*, 1935, 1161-1172; and *Proc. Amer. Soc. Test. Mat.*, 1935, 35, (I)).—Cover wire and cable insulated with a vulcanized rubber compound.—S. G.

Copper Roofs. — (*Bull. Copper Brass Res. Assoc.*, 1936, (85), 10-11).—The uses of copper and its alloys in the construction of roofs are illustrated. Copper sheets are used to make houses termite-proof. A copper shingle, easy to apply, has recently been introduced for roofing purposes.—J. S. G. T.

Drama of the Skies under a Copper Dome. — (*Bull. Copper Brass Res. Assoc.*, 1936, (85), 13).—The construction of the copper dome of the Hayden Planetarium, New York, is illustrated. When finished, the dome was washed with lye and sprayed with acid to hasten formation of a patina finish.

—J. S. G. T.

Copper and Its Alloys. — (*Bull. Copper Brass Res. Assoc.*, 1936, (85), 8-9).—The use of copper and its alloys in the building of the town of Hershey, Pennsylvania, is briefly illustrated.—J. S. G. T.

Wider Colour Range of Copper Metals is Available with Nickel Silver Alloys. — (*Bull. Copper Brass Res. Assoc.*, 1936, (85), 14).—Copper-nickel-zinc alloys of colours ranging from the white of nickel silver through those of copper, brass, to those of bronze are now available for architectural, decorative, and other structures, which are illustrated.—J. S. G. T.

Automobile Industry, a Large Copper Consumer. — (*Bull. Copper Brass Res. Assoc.*, 1936, (85), 2-7).—The development of travel in America and the growth of the automobile industry are briefly illustrated. This industry, next to the electrical industry, is the largest consumer of copper and its alloys in the country.—J. S. G. T.

Iron and Copper Bonded in Composite Cylinder Heads. Irving E. Aske (*Automotive Ind.*, 1935, 73, 724-727, 733-734).—A combination of cast iron

and copper in automobile cylinder heads results in lower heat losses to the jacket through the iron, and prevents excessive rise in temperature at the end of the combustion process. The method of casting is described; a special type of cast iron must be used, and the design of the copper insert must be varied according to the form of the combustion chamber. Comparative curves show the improved performance of composite cylinder heads as against similar members of "high conductivity alloy" and cast iron. Copper inserts are stated to be more effective than those of aluminium.—P. M. C. R.

Copper Plating for Power. — (*Motor*, 1936, 68, 1063).—The improved performance effected by spraying the combustion heads of motor engines with aluminium led to the experimental use of copper plating on both cylinder heads and valves. Subject to necessary adjustments in the composition of the mixture, the pulling power of the engine tested was increased by 20%, with a considerable decrease in fuel consumption; cooler running was also noted. A reference is made to a compound cylinder head, of cast iron with pinned copper inserts, where the thermal conductivity of the copper is used in cooling. (Cf. preceding abstract.)—P. M. C. R.

Tentative Specifications for Copper-Silicon Alloy Wire for General Purposes (B 99-35 T). — (*Book of A.S.T.M. Tentative Standards*, 1935, 359-361; and *Proc. Amer. Soc. Test. Mat.*, 1935, 35, (I)).—Cover round copper-silicon alloy wire for general structural purposes except for electrical transmission cable. Requirements as to chemical composition are: silicon 1.00-5.00; manganese (maximum) 1.50; zinc (maximum) 5.00; iron (maximum) 2.50; tin (maximum) 2.00; aluminium (maximum) 2.00; copper remainder; sum of above elements (minimum) 99.50%.—S. G.

Tentative Specifications for Bronze Trolley Wire (B 9-35 T). — (*Book of A.S.T.M. Tentative Standards*, 1935, 338-343; and *Proc. Amer. Soc. Test. Mat.*, 1935, 35, (I)).—These are in effect a revision of, and are intended to replace when adopted, the present Standard Specifications (B 9-32). They cover round and grooved bronze trolley wire.—S. G.

Bearing Bronzes. — (*Copper Development Assoc. Publ. No. 15*, 1935, 31 pp.).—Deals with requirements of a bearing metal, general range of British bearing bronzes, properties of copper-tin bearing bronzes, bronze bearing shells, bearing brasses, copper-lead bearing alloys ("lead-bronzes"), bushes for light-duty applications, bearings moulded from copper powder mixtures, installation of bronze bearings, and where to specify bronze or bronze-backed plain bearings. A table of some typical bearing bronzes (compositions, average mechanical properties, and applications) is given.—S. G.

Tentative Specifications for Wrought Phosphor-Bronze Bearings and Expansion Plates for Bridges and Structures (B 100-35). — (*Book of A.S.T.M. Tentative Standards*, 1935, 326-329; and *Proc. Amer. Soc. Test. Mat.*, 1935, 35, (I)).—Cover two classes of wrought bronze bearing metals for movable bridges and structures: *Class A.*—for contact with hardened steel disks under pressures over 1500 lb./in.², e.g. bearing metals, expansion plates, &c., used in centre-bearing swing bridges, and *Class B.*—for contact with soft steel at low speeds under pressures not over 1500 lb./in.², e.g. expansion plates, &c., trunnions and journals of bascule and lift bridges. The requirements as to chemical composition are: *Class A.*—tin (minimum) 7.0, phosphorus 0.05-0.50%, copper remainder, copper + tin + phosphorus (minimum) 99.50%; *Class B.*—tin (minimum) 3.5, phosphorus 0.05-0.50%, copper remainder, copper + tin + phosphorus (minimum) 99.50%.—S. G.

Brass and Other Copper Alloy Wire and Wire Products. — (*Copper Development Assoc. Publ. No. 16*, 1935, 49 pp.).—Deals with composition and mechanical properties, sizes and shapes available, applications (rivets, pins, and cold-headed products; screws, bolts, and screwed products; chains and bent products; springs; gauze cloth, &c.); and production and treatment

(wire manufacture, annealing and heat-treatment, pickling and bright dipping, colouring). Weight tables complete the booklet.—S. G.

Crank-Case Oil Improved [Tests on Bearing Metals]. — (*Nat. Petrol. News*, 1935, 27, (46), 38–42).—A series of film-strength and wear tests in the Timken and Alman machines is described in connection with the effect of lubricating oil containing various additions on the performance of bearing metals. The materials tested were a cadmium-silver alloy, "S.A.E. 11," a bearing bronze (F1), and a copper-lead alloy, and the wear of steel on steel, bronze, and brass was studied. A Sibley corrosion-testing machine, which incorporated a connecting-rod bearing, was used in further tests on copper-lead and cadmium-silver bearings lubricated with a variety of treated oils. The cadmium-silver alloy was highly resistant to ordinary corrosion and to wear in the Timken machine, but its wearing quality as tested by the Sibley machine was inferior to that of copper-lead.—P. M. C. R.

Tentative Specifications for Lead-Coated Copper Sheets (B 101-35 T). — (*Book of A.S.T.M. Tentative Standards*, 1935, 344–347; and *Proc. Amer. Soc. Test. Mat.*, 1935, 35, (I)).—Cover lead-coated sheet copper for architectural uses. It is supplied in two types (Type I, by application of molten lead; Type II, by electrodeposition) according to the method of manufacture, and in three classes according to weight of coating.—S. G.

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

Tentative Specifications for Lead and Tin-Base Alloy Die-Castings (B 102-35 T). — (*Book of A.S.T.M. Tentative Standards*, 1935, 364–365; and *Proc. Amer. Soc. Test. Mat.*, 1935, 35, (I)).—Cover die-castings made by pressure casting from the following alloys: tin-base, lead-base, and intermediate. Five typical alloys are specified, designated Grades 1–5, in order of decreasing tin content.—S. G.

Magnesium in Aeronautical Construction. R. de Fleury (*Publ. Sci. Tech. Ministère de l'Air*, No. 75, 1935, 112 pp.).—Recent French work on the constitution of magnesium alloys, on the recovery and refining of magnesium, and on the casting, working, and uses of the metal and its alloys is summarized and discussed.—A. R. P.

Molybdenum: Its Sources and Industrial Uses. Maurice Dérivé (*Métaux et Machines*, 1935, 19, 407–411).—An account is given of the occurrence and principal natural compounds of molybdenum; molybdenite and wulfenite are described in some detail. The extraction and physical and chemical properties of the metal are considered, and the uses of the more important salts of molybdenum, of the metal itself, and of its alloys (mainly ferrous) are enumerated.—P. M. C. R.

Marking Articles Made of Silver in Combination with Gold. — (*[U.S.] Bur. Stand. Commercial Standard*, CS 51-35, 1935, 9 pp.).—Covers marking for sale in the U.S.A.—S. G.

Tin and Its Uses. D. J. Macnaughtan (*Misc. Publ. Internat. Tin Res. Develop. Council*, 1935, (4), 16 pp.).—The uses of tin in bronzes, bearing metals, solders, die-casting alloys, pewter, and tinplate are briefly reviewed.

—A. R. P.

Advances in the Field of Hard Metals. Karl Becker (*Metallwirtschaft*, 1935, 14, 1004).—A review of recent patent literature.—v. G.

Tentative Revision of Standard Specifications for Slab Zinc (Spelter) (B 6-33). — (*Book of A.S.T.M. Tentative Standards*, 1935, 1517; and *Proc. Amer. Soc. Test. Mat.*, 1935, 35, (I)).—Amendments are made to Sections 1, 2, 4, and 8.—S. G.

The Use of Cast Materials [—I.—II.]. Albert Achenbach (*Werkstatt u. Betrieb*, 1935, 68, 285–288, 316–318).—(I.—) Deals with cast ferrous materials only. (II.—) The advantages and special applications of castings of lead, ordinary

and special bronzes, brass (including red brass, Delta, and Durana metal), nickel, and the nickel-iron and nickel-copper alloys, are indicated, and certain necessary precautions in the selection of materials are indicated in each case.

—P. M. C. R.

XXII.—MISCELLANEOUS

(Continued from pp. 23-24.)

The Institute for Metallurgical Engineering and Electrometallurgy at the Technical High School, Aachen. Paul Röntgen (*Metall u. Erz*, 1935, 32, 265-269; and *Abhandl. Inst. Metallhütt. u. Elektromet. Tech. Hochschule Aachen*, 1935, [N.F.], 3, 5 pp.).—S. G.

The Nickel Industry in 1935. R. C. Stanley (*Amer. Metal Market*, 1936, 42, (247), 2).—A review.—L. A. O.

The Zinc Industry in 1935. E. V. Gent (*Amer. Metal Market*, 1936, 43, (9), 3, 6).—Economic.—L. A. O.

Some Problems of Metal Physics. Walther Gerlach (*Metallwirtschaft*, 1935, 14, 1010-1012).—A popular lecture on the importance of physical points of view in the study of metals.—v. G.

Metallurgical Progress. Its Bearing on the Electrical Industry. L. Sanderson (*Elect. Rev.*, 1935, 117, 444).—J. C. C.

Salvaging and Reclaiming Items in Every-Day Uses. T. H. Owens (*Amer. Metal Market*, 1935, 42, (118), 6, 7; (120), 6, 7).—Methods used by the Westinghouse company are briefly outlined.—A. R. P.

Research Laboratory of the London, Midland and Scottish Railway. — (*Met. Ind. (Lond.)*, 1935, 47, 591-593).—See also *Met. Abs.*, this vol., p. 24. The equipment of a large modern research laboratory is described.—J. H. W.

Research and Management. Peter A. Thiessen (*Metallwirtschaft*, 1935, 14, 1007-1009).—The need for high schools and universities in connection with the advancement of the science of metals is shown.—v. G.

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XXIV.—BOOK REVIEWS

Modern Uses of Non-Ferrous Metals. Edited by C. H. Mathewson. (A.I.M.M.E. Series.) Post 8vo. Pp. x + 427, illustrated. 1935. New York: American Institute of Mining and Metallurgical Engineers. (\$3.00 net.)

This is one of the series of books sponsored by the Seeley W. Mudd Memorial Fund Committee of the American Institute of Mining and Metallurgical Engineers, and has been specially written for the junior members of the metallurgical and engineering professions. It contains twenty-one chapters written by well-known metallurgists who survey the common non-ferrous metals and many minor metals so far as possible in non-technical language and narrative style.

The first chapter, by Zay Jeffries, deals with the new industrial development and exploitation of metals and alloys but includes an account of the occurrence of metals in the earth, the nature of metallic products, the constitution of alloys, and the future of the non-ferrous metal industry. In connection with this latter subject, the author concludes that it is practically certain that the suitability of non-ferrous metals for engineering purposes will be in much greater proportion to iron than the recent ratio of the consumption of these metals and also

that in selecting metals in the future, engineering suitability will gradually be given a greater weight as compared with cost.

In most of the chapters the occurrence and methods of extraction and properties of the metals are dealt with very briefly, the greater portion of the matter being devoted, as indicated by the title, to the uses to which they are put.

Twenty-one of the twenty-two authors responsible for the matter of the book are engaged in American metallurgical work; the exception is D. J. Macnaughtan of the International Tin Research and Development Council, London, who has written on tin; and his choice could not have been bettered for the subject-matter of this chapter. The book is well written and forms easy reading, and at the same time gives useful information on many matters not easily accessible in laboratories. It is curious that the chapter on chromium should be, for the most part, devoted to iron and steel alloys.

The book will undoubtedly prove useful both as an introduction to the study of non-ferrous metals and alloys to engineers and students studying metallurgical subjects, and as a revision book for metallurgists who have been inclined to specialize too strongly on one metal or on a limited branch of the subject only.—C. O. BANNISTER.

General Foundry Practice. By Andrew McWilliam and Percy Longmuir. Fourth Edition, Revised Throughout and Enlarged by Percy Longmuir. Med. 8vo. Pp. viii + 457, with 2 Plates and 303 illustrations in the text. 1935. London: Charles Griffin and Co., Ltd. (21s. net.)

The present edition of this book, which has come to be regarded as one of the standard works on foundry practice, has been enlarged by a further 73 pages and 57 illustrations and improved by a general re-arrangement of the later chapters. The scope of the book has been extended to include modern plant and equipment, and developments in alloys, such as improved drying stoves, electric, oil and pulverized-fuel melting furnaces, alloy steels and cast irons, &c.

In certain directions the revision could have been more complete. More recent types of base-metal couples and recorders might have been mentioned. Whilst the chapter on non-ferrous alloys has been enlarged in certain directions, the importance of the subject, especially aluminium-base light alloys, calls for fuller treatment than has been given. No reference is made to the troubles associated with the casting of these alloys or to the various treatments evolved in recent years for overcoming them. The specification quoted for Admiralty gun-metal has been obsolete for some years. The photomicrographs in Chapter XXXVIII could have been improved and made more representative.

These few shortcomings do not seriously detract from the value of this work, which is so well known to all associated with foundries. The binding and printing are excellent, and the Index has been carefully compiled.—J. E. NEWSON.

Electric Melting Practice. By A. G. Robiette. Med. 8vo. Pp. viii + 324, with 87 illustrations, including 3 folding plates. 1935. London: Charles Griffin and Co., Ltd. (15s.)

The author provides an up-to-date review of electric furnace applications to the melting of ferrous and non-ferrous metals and alloys. The book gains much advantage from his practical acquaintance with the installation of such plant in this country, and the survey of published information on British and foreign practice is well done. No attempt has been made to deal with the early history and the many forms of plant which led up to those which are in successful operation to-day, and the book has thus been kept within reasonable compass.

The economics of electric melting compared with fuel melting are adequately dealt with, so far as the ordinary reader is concerned, and the relative advantages of different types of electric furnace appear to have been fairly put forward. A most useful summary is given of the work which has been carried out on the mechanism and reactions concerned in the refining of steels in arc and coreless induction furnaces.

A chapter on resistor melting furnaces is particularly welcome, as it refers to the melting of aluminium and the heating of galvanizing baths, applications in which this country seems to have rather lagged behind others and where considerable developments are to be expected within the next few years.

Who's Who, 1936. Eighty-Eighth Year of Issue. Post 8vo. Pp. lx + 3764. London: A. & C. Black, Ltd. (60s.)

The new edition of "Who's Who" serves to remind us of the loss to Britain and to the world of him who, when the book was issued last month, was still the revered head of the British Commonwealth of Nations. The first entries are those of His late Majesty King George V, of whose photographs three excellent reproductions are given, and of his son, now King Edward VIII, whose well-known features figure in two excellent plates.

The rest of the biographies, numbering tens of thousands, follow the lines of those which have appeared in "Who's Who" for many decades, and go to make up an ever-swelling volume as humanly interesting as it is indispensable.