

METALLURGICAL ABSTRACTS

(GENERAL AND NON-FERROUS)

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Part 3

I.—PROPERTIES OF METALS

(Continued from pp. 65-68.)

***On the Temperature Coefficient [of Resistance] of Aluminium.** O. Scarpa (*Alluminio*, 1933, 2, 317-322).—The temperature coeff. of electrical resistance, which may be absolute, real, mean, or relative, is discussed, and an expression is derived for calculating the mean relative coeff. of aluminium and of other metals for which $\rho = f(t)$ is not linear. The most probable actual coeff. for commercial aluminium is 0.0040 (0°-100° C.). From the experimental results of Holborn the existence of an allotropic change in aluminium near 0° C. is inferred.—G. G.

***The Thermal Expansion of Bismuth [Determined] by X-Ray Measurements.** A. H. Jay (*Proc. Roy. Soc.*, 1934, [A], 143, 465-471).—X-ray powder photographs of bismuth at temperatures between 18.5° and 268° C. are used to determine the crystal lattice dimensions for each temperature of observation, and the results are compared with those determined optically. The present X-ray measurements disagree with those of Goetz and Hergenrother, and show that the lattice expansion agrees with the expansion of the specimen as a whole. The expansion curve indicates a steady expansion from 20° to 70° C., a sudden increase between 70° and 80° C., a linear expansion thereafter up to 240° C., followed by a decrease after 250° C. The nature of the changes in the lattice dimensions just below the melting point (271° C.) is discussed.—J. S. G. T.

Some Remarks on the Vapour Pressure of Cæsium. I. H. de Boer and C. J. Dippel (*Z. physikal. Chem.*, 1933, [B], 21, 273-277).—From a discussion of the vapour-pressure formulæ of cæsium given in the literature it is concluded that the relative vapour pressures are best calculated from Langmuir and Kingdon's formula, whilst that of Kröner gives the most likely absolute values.—v. G.

***The Potential of the Cobalt Electrode.** M. M. Haring and B. B. Westfall (*Electrochem. Soc. Preprint*, 1934, April, 61-72).—The standard potential of cobalt in cobalt chloride solution is -0.278 ± 0.002 v. at 25° C., hence the normal potential is close to -0.300 v. Pure metal, free from stress, prepared by high current density electrolysis must be used in the determination under oxygen-free conditions.—A. R. P.

***The Emission of Electricity from [Niobium] Columbium. [Electronic Work-Function of Nb].** H. B. Wahlin and L. O. Sordal (*Phys. Rev.*, 1933, [ii], 44, 1030).—A note. When heated to the point where vaporization becomes appreciable, niobium yields positive ions of the metal itself. The positive ion work-function was determined as 5.52 v. from the relation $i = BTe^{-\phi/kT}$ due to Fowler. The electronic work-function is 3.96 v., with $A = 57$ amp./cm.²/degree².—W. H. R.

***Copper Embrittlement—II.** L. L. Wyman (*Amer. Inst. Min. Met. Eng. Preprint*, 1932, 1-11).—The previous work on the embrittlement of copper (cf. *J. Inst. Metals*, 1932, 50, 722) is extended to additional materials. These include 3 groups of deoxidized coppers as follows: (1) double-deoxidized copper using silicon and calcium boride; calcium-deoxidized coppers having

* Denotes a paper describing the results of original research.

† Denotes a first-class critical review.

various calcium contents; (3) double-deoxidized coppers using silicon or calcium boride with a constant amount of calcium. The results fall into a narrow range, penetration over 0.011 in. not being observed. In addition, the examinations are supplemented by wire bead tests. The results obtained are as follows: (1) the addition of calcium in small amounts (lot 2, 0.0375%) gives superior qualities as regards resistance to embrittlement; (2) excessive calcium additions prove detrimental to physical properties (bend test) of copper; (3) none of the calcium coppers appears to be detrimentally affected by the usual copper embrittlement; (4) double-deoxidized copper has shown superiority over single deoxidation, for similar or larger amounts of the same deoxidants. Lot 2 may be an exception. (See also Part III, *J. Inst. Metals*, 1933, 53, 689.)—S. G.

***Properties of Copper Deoxidized with Calcium.** Lyall Zickrick (*Amer. Inst. Min. Met. Eng. Preprint*, 1932).—A high-calcium copper alloy has been found to deoxidize copper satisfactorily. Residual calcium remaining in the metal, like residual silicon, increases the annealing temperature required to produce dead soft copper; 0.05% residual calcium increases the annealing temperature of copper from 250° C. to approximately 350° C., and when present in amounts up to 0.20% the required annealing temperature is in the neighbourhood of 400° C. Owing to the very slight solubility of calcium in copper in the solid state, residual calcium does not decrease the electrical conductivity of copper as silicon does. For a specific illustration, it was found that 0.03% residual calcium decreased the conductivity of dead soft copper from 101 to 97%, whereas 0.03% residual silicon causes a decrease from 101 to 75%.—S. G.

***Investigation of Copper Oxide Films by Electron Diffraction.** C. A. Murison (*Phil. Mag.*, 1934, [vii], 17, 96–98).—The structures of the oxide films formed on copper by heating and of the powdered oxides of copper were studied by the method of electron diffraction. The powdered oxides give the cuprous or cupric oxide structures; the surface films give only cuprous oxide or an unknown structure which can be produced by blowing air over a reheated cuprous oxide film. Chemical analysis shows that the film of unknown structure is a new form of cupric oxide.—J. S. G. T.

The System PbO-Sb₂O₃ and Its Relation to Lead Softening. C. G. Maier and W. B. Hincke (*Trans. Amer. Inst. Min. Met. Eng.*, 1932, 102, 97–106; discussion, 107).—See *J. Inst. Metals*, 1932, 50, 211.—S. G.

***Field Electron Emission from Liquid Mercury.** J. W. Beams (*Phys. Rev.*, 1933, [ii], 44, 803–807).—The strong field emission from liquid mercury at a temperature just above its freezing point has been investigated by applying an impulsive potential of the order 10^{-6} seconds duration between a spherical steel anode and a plane mercury cathode. Under these conditions the field just necessary to produce breakdown is a measure of field necessary to produce cold emission, since it is this emission which starts the breakdown. The critical fields were sharply defined and varied from 3.5×10^5 v./cm. for impure mercury to 1.8×10^6 v. for very pure redistilled mercury. These magnitudes are much smaller than those required by the Fowler–Nordheim electron theory of metals, and the possible bearing of this discrepancy on the structure of liquid metallic surfaces is discussed. The problem is also of importance from the point of view of the mercury arc lamp.—W. H.-R.

***Magnetization and Magneto-Resistance in the Study of the Magnetic Properties of Ferromagnetic Substances [Nickel].** Giulia Alocco (*Nuovo cimento*, 1933, 10, 153–168; *Chem. Zentr.*, 1933, 104, II, 2244).—Magnetic hysteresis curves and curves showing the change in resistance during longitudinal magnetization of drawn, twisted, and bent nickel wires at 20° C. have been determined. The results confirm the assumption that mechanical deformation produces an orientation of the elementary moments in directions the inclination

of which to the wire axis increases with increasing degree of deformation. The results for nickel are compared with those obtained with other ferromagnetic metals and alloys.—A. R. P.

***Magnetic Analysis of Nickel Films Deposited by Evaporation.** [Strain in Metallic Films.] H. N. Otis (*Phys. Rev.*, 1933, [ii], 44, 843-849).—Films of nickel were deposited by evaporation on surfaces of copper, molybdenum, glass, and mica, at temperatures from 25° to 350° C. The magnetic properties of the films, both as deposited and after annealing at various temperatures, were then studied at room temperature. Films deposited at low temperatures are magnetically hard with low initial susceptibility (χ_0). For films deposited on a metal with a higher coeff. of linear expansion than nickel, χ_0 increases with increase of temperature of annealing or deposition. For films on a metal with a lower coeff. of expansion than nickel, χ_0 first increases with rise of deposition or annealing temperature, but decreases on annealing at still higher temperatures. Films deposited on metals at low temperatures peeled from the support when the film thickness reached 800-1000 m μ , but this stopped when the deposition temperature reached 100° C., and peeling was never observed on the non-metallic supports. The results are explained by Becker's theory by assuming that the films are deposited under strain which becomes less at higher temperatures. Since the deposition occurred at pressures of 10^{-4} to 10^{-5} mm. of mercury, the results suggest that intense strain can be produced by the mere formation of the lattice at low temperatures, as distinct from the effect of occluded gas.—W. H. R.

***The Thermionic Constants for Platinum.** H. L. Van Velzer (*Phys. Rev.*, 1933, [ii], 44, 831-836).—The thermionic constants for cylindrical filaments of platinum have been investigated by the analysis of Schottky curves (cf. Van Velzer and Ham, *ibid.*, 1929, [ii], 33, 1081). Three distinct stages were noted during the process of degassing and ageing. The currents were first large and erratic, but a steady state was then reached which withstood ageing for 175 hrs. at 1650° K., and gave high values of both ϕ and A in the thermionic equation. It is this value of A which has previously been taken for that of pure platinum, but it is really characteristic of an intermediate, impure, stable condition. Further ageing at 1785° K. gave values of A as low as 170 ± 20 amp./cm.²/degree², and suggested that A was approaching the theoretical value of 60, and if A is assumed to be 60, the most probable value of ϕ for really clean platinum is 5.29 v., although this stage was never reached experimentally. The results suggest that the temperature of ageing is more important than the time, and experiments on forced ageing are described.—W. H. R.

***The Kinetics of Electrode Processes. III.—The Behaviour of Platinum and Gold Electrodes in Sulphuric Acid and Alkaline Solutions Containing Oxygen.** G. Armstrong, F. R. Himsworth, and J. A. V. Butler (*Proc. Roy. Soc.*, 1934, [A], 143, 89-103).—Experiments supporting the view that the anodic polarization of platinum electrodes in sulphuric acid or alkaline solutions is accompanied by the formation of a single layer of adsorbed oxygen atoms on the electrodes are discussed. On cathodic polarization the reduction of the adsorbed layer occurs simultaneously with depolarization of dissolved oxygen in the solution. When gold electrodes are polarized in dilute sulphuric acid, the formation of a definite oxide begins when the potential reaches the value ± 1.27 v. The efficiency of oxide formation falls steadily from 100% in the earliest stages to a final constant value of 0.9%. In alkaline solutions gold behaves very similarly to platinum.—J. S. G. I.

Three of the Platinum Group of Metals: Iridium, Osmium, and Ruthenium and Their Uses in Alloys. F. Carter (*Amer. Metal Market*, 1933, 40, (65), 7; and (short abstract) *Met. Ind.* (Lond.), 1933, 42, 570).—The principal application of these metals is to the hardening of platinum. The properties and

uses of several grades of iridio-platinum are described. The hard osmium-iridium and osmium-iridium-platinum alloys are also of some importance, as is a platinum-ruthenium alloy. The high-temperature behaviour of the 3 metals is discussed.—P. M. C. R.

***The Thermal Expansion of the Crystal Lattices of Silver, Platinum, and Zinc.** E. A. Owen and E. L. Yates (*Phil. Mag.*, 1934, [vii], 17, 113-131).—A high-temperature precision X-ray camera is employed to measure the expansion of silver, platinum, and zinc at temperatures between 20° and 600° C. in the case of silver and platinum and from 20° to 415° C. in the case of zinc. Values of the coeffs. of expansion of silver and platinum so determined agree closely with previously determined values. The thermal expansion of zinc was measured along, and perpendicular to, the hexagonal axis. The zinc lattice continues to expand up to within 4° C. of the melting point. Expansion occurs along both these directions, but whereas the rate of change of base side increases, that of the height decreases as the melting point is approached. The thermal expansion of the crystal lattice of zinc is the same as that of the metal in bulk.—J. S. G. T.

Tellurium and Selenium. Anon. (*Indust. Australian*, 1934, 88, 377-378).—The occurrence, principal ores, and chief physical and chemical properties of selenium and tellurium are described. A summary of their industrial applications, which are mainly of very recent development, includes the use of both elements in radio-telephony.—P. M. C. R.

Alternating Torsional Tests with Zinc Crystals. W. Fahrenhorst and E. Schmid (*Mitt. Material., Sonderheft* 19, 1932, 36-43).—Reprinted from *Z. Metallkunde*, 1931, 23, 323-328. See *J. Inst. Metals*, 1932, 50, 467.

—S. G.

***Concerning the Thermoelectric Effects of the Alkalis.** A. Sommerfeld (*Phys. Rev.*, 1934, [ii], 45, 65-66).—A note. Except for lithium, the results of Bidwell (*J. Inst. Metals*, 1925, 34, 382) for the thermoelectric properties of molten alkali metals, are in good agreement with those predicted by the more detailed theory of S. (*Handbuch der Physik*, 24, 2: Julius Springer, Berlin).—W. H. R.

***On the Effect of Temperature of Liquid Hydrogen (— 252.8° C.) on the Tensile Properties of Forty-One Specimens of Metals Comprising (a) Pure Iron 99.85%; (b) Four Carbon Steels; (c) Thirty Alloy Steels; (d) Copper and Nickel; (e) Four Non-Ferrous Alloys.** W. J. de Haas and Robert Hadfield (*Phil. Trans. Roy. Soc.*, 1933, [A], 232, 297-332; and (abstract) *Nickel Bull.*, 1934, 7, 4).—Tensile tests have been carried out at — 252.8° C. on the above metals and alloys, and the results compared with previous work at the temperature of liquid air. The hardness of the specimens was also measured after the tests. The non-ferrous metals examined were (a) nickel of 99.27 and 99.4% purity; (b) copper of 99.6 and 99.7% purity; (c) Monel metal containing nickel 67.0, and copper 30.2%; (d) phosphor-bronze (tin 10.0, copper 88.38, zinc 1.61%); (e) Duralumin (manganese 0.75, magnesium 0.57, aluminium 94.0 approx., copper 4.1, iron 0.42%); and (f) an alloy containing nickel 78.9, chromium 18.9, manganese 1.41, silicon 0.20, carbon 0.31%. In general the non-ferrous alloys retain excellent mechanical properties at — 252.8° C., the tenacity being increased, and the ductility left unimpaired or improved, except with phosphor-bronze, where the ductility is much reduced. At — 252.8° C., copper has a tenacity of 29.70 tons/in.², and an elongation of 60%. This is in contrast to iron (carbon 0.04, and silicon 0.07%), ordinary steels, and most of the alloys of iron for which the ductility becomes zero at the very low temperature, although steels containing a high percentage of nickel retain a considerable ductility. The original must be consulted for the conditions of the alloys (cast, worked, annealed, &c.) which vary greatly. [Note by abstractor: the term "tenacity" is used in the paper for "maximum tensile stress."]—W. H. R.

Report of Committee B-2 [of A.S.T.M.] on Non-Ferrous Metals and Alloys. William Campbell and E. E. Thum (*Proc. Amer. Soc. Test. Mat.*, 1933, 33, (1), 226-231).—See *J. Inst. Metals*, 1933, 53, 485.—S. G.

Report of Joint Research Committee [of A.S.T.M. and A.S.M.E.] on Effect of Temperature on the Properties of Metals. Progress Report to the Sponsor Societies. H. J. French and N. L. Mochel (*Proc. Amer. Soc. Test. Mat.*, 1933, 33, (1), 209-212).—See *J. Inst. Metals*, 1933, 53, 486.—S. G.

***The Temperature Coefficients of the Elastic Modulus of Ferromagnetic Materials.** M. Kersten (*Z. Physik*, 1933, 85, 708-716).—The practical constancy of the elastic modulus of the Elinvars (iron-nickel alloys containing 30-40% nickel) at room temperatures is explained by an application of Becker's theory correlating magnetization, magnetostriction, and specific stresses. Inconstancy of the temperature coeff. of the elastic modulus in the region of the Curie point is explained, at least partly, by the non-occurrence of magnetostriction thereat.—J. S. G. T.

***The Latent Energy Remaining in a Metal after Cold-Working.** G. I. Taylor and H. Quinney (*Proc. Roy. Soc.*, 1934, [A], 143, 307-326).—Measurements of the latent energy remaining in metal rods after severe twisting are described. Very much more cold-work can be done on a metal in torsion than in direct tension. As the total amount of cold-work increases the proportion absorbed decreases. Experimental results for copper indicate that saturation would be reached at a plastic strain very little greater than the strain at fracture. The amount of work necessary to saturate copper at 15° C. with latent energy is slightly greater than 14 cal./gram. By using compression instead of torsion it was found possible to do much more cold-work than this on copper, and compression tests showed that the compressive stress increases with increasing strain until the total applied cold-work is 15 cal./gram. No further increase in compressive stress occurred with further compression, although the specimen was compressed to $\frac{1}{3}$ of its original height. The strength of pure metals may depend only on the amount of cold-work latent in them.—J. S. G. T.

***Fatigue and Corrosion-Fatigue with Special Reference to Service Breakages.** Frederic Bacon (*Proc. Inst. Mech. Eng.*, 1933, 124, 685-736).—The fractured faces of shafts, axles, and similar parts subject to bending moment as they rotate show that constantly recurring types approximate to simple geometrical markings. These are all fatigue fractures in which creeping cracks have gradually advanced until the residual area is unable to carry the load, and ruptures in a brittle manner. The crack-crept zone is sharply distinguished from the ruptured core, the curvature of the boundary between the two depending on the variations of stress concentration under which the cracks start. Failures with this kind of fracture have been produced experimentally by fatigue tests in a machine of the revolving-beam type giving a uniform rotary bending moment along the specimen. Beams of circular section are first discussed, and then the stresses in revolving beams of square section, and of round section with equal parallel flats are dealt with at length, theory and experiment being in agreement. The effect of local stress concentrations caused by holes, shoulders, keyways, &c., is discussed, and the problem of corrosion-fatigue dealt with briefly. The experiments refer to steels, but the results are of general interest.—W. H.-R.

***Cutting Tools Research Committee. Report on the Ageing of Tool Steel.** [Periodic Changes in Hardness of Metals and Alloys.] E. G. Herbert (*Proc. Inst. Mech. Eng.*, 1933, 124, 645-683).—Periodic changes in hardness were observed in freshly hardened tool steel, and also in high-speed steel during and after the secondary heat-treatment. Experiments with nickel, iron, gold, brass, and Duralumin suggest that periodic fluctuations in hardness are a general characteristic of metals after severe mechanical deformation or disturbance by thermal or magnetic treatment. These changes may be

connected with magnetic properties, and in some cases the metal may be stabilized by magnetic treatment. The remainder of the paper describes attempts to use these facts to improve the quality of tool steel.—W. H. R.

***The Rate of Heating of Metals by Surface Combustion.** W. Davies (*Phil. Mag.*, 1934, [vii], 17, 233-251).—The rates of electric heating of platinum, palladium, gold, and silver wires in binary and ternary mixtures of hydrogen, carbon monoxide, and air have been determined. Results obtained with platinum and palladium wires are in accordance with Langmuir's theory of the catalytic oxidation of gases on solids. The effective rate of combustion on these two wires is governed by diffusive and convective processes limiting the rate of transfer of the reacting gases to the surface of the wires. The slow diffusive process has an important bearing on the problem of the ignition of explosive gaseous mixtures by hot wires. In the cases of gold and silver wire no evidence was obtained of heating due to surface combustion in mixtures of hydrogen and air or carbon monoxide and air at temperatures below the ignition points of the mixtures.—J. S. G. T.

Diffusion in Metals. Christian Specht (*Metallbörse*, 1933, 23, 447, 509-510, 542).—A review of recent work.—A. R. P.

***Thermoelectric Force of Thin Films.** E. A. Johnson and Louis Harris (*Phys. Rev.*, 1933, [ii], 44, 944-945).—Measurements have been made of the thermoelectric force of thermocouples consisting of two thin films of antimony and bismuth prepared by sputtering in purified argon. The e.m.f. per degree was independent of the thickness of the antimony film, but, when the thickness of the bismuth film was less than 10^{-4} cm., the sensitivity diminished rapidly as the film of bismuth became thinner. Thicknesses above 10^{-4} cm. gave an e.m.f. corresponding with that of massive bismuth-antimony, and the curve connecting the e.m.f. per degree with the thickness of the bismuth film shows a marked bend at about 10^{-4} cm. The smoothness of the curve suggests that the change is not due to contamination by gases, but to a change of crystalline orientation in the thin layer.—W. H. R.

Influence of the Thermal Conductivity of the Metals on Their Utilization in the Chemical Industry, Notably the Manufacture of Acids and Explosives. Stefan Zdenek (*Chim. et Ind.*, 1933, 29, Special Number (June), 964-975).—A discussion of the factors which influence the conductivity of metals and also those which make this an important feature in determining their use for industrial purposes. A large number of metals and alloys is considered, including copper, copper with various additions of phosphorus, gold, zinc, nickel, brass (70% Cu), bronze (85% and 87% Cu), platinoid (55% Cu), aluminium alloys. The incidence of corrosion is the most vital determining factor when employing metals or alloys for chemical plant, and the relationship between this and the conductivity factor is specially considered. Tables and diagrams indicating the results which have been obtained are freely given.

—W. A. C. N.

***On the Calculation of the Specific Heat of Solids.** K. Honnefelder (*Z. physikal. Chem.*, 1933, [B], 21, 63-64).—From theoretical considerations the experimental values given in the literature for copper, cadmium, tungsten, tin, and zinc have been confirmed.—v. G.

***On Photoactivity of Anodically-Polarizing Peroxide-Forming Metals.** V. Sihvonen and A. Jussila (*Suomen Kemi*, 1933, [B], 6, 65-66; *Chem. Zentr.*, 1933, 104, II, 2239).—On illuminating with a projection apparatus or mercury-vapour lamp a silver anode in dilute sodium hydroxide or a lead anode in dilute sulphuric acid a reduction of several tenths of a volt in the anodic potential occurs at a definite current density. A study has been made of the relation between the anodic polarization and the potential at which photo-activity occurs, and of the effect of varying the light intensity. The photo-lytic process appears to consist in the decomposition of the peroxide. A

feeble photoactive effect has been observed with platinum, nickel, copper, iron, and graphite.—A. R. P.

***On the Exchange Between Atoms and Ions of a Metal.** Otto Erbacher (*Z. physikal. Chem.*, 1933, [A], 166, 23–26).—Cf. *J. Inst. Metals*, 1933, 53, 292. The formation of local elements in systems comprising a metal immersed in a solution of one of its ionized salts leads to an exchange in a great number of atomic layers. When, however, etched specimens of lead or bismuth are immersed in solutions of their salts, only 3–4 times as much metal is exchanged as would be necessary to produce a monatomic layer on the same metals after rubbing with emery paper, hence the action of local elements can only be very slight in these cases, and, since the active surface of metals roughened with emery is probably less than that of etched metals, it is more likely that active local elements are not formed, but that a kinetic exchange corresponding with a monatomic coating takes place.—B. Bl.

***Magneto-Striction.**—III. Alfred Schulze (*Wiss. Abhandl. Physikal.-Tech. Reichsanst.*, 1933, 17, 144–153).—Reprint from *Z. Physik*, 82, 674–683; see *J. Inst. Metals*, 1933, 53, 547.—M. H.

***Light Absorption by Metals.** A. Smakula (*Physikal. Z.*, 1933, 34, 788–790).—Read at the conference of the IX Deutsche Physikertag, Sept., 1933. Hitherto, investigations have shown that, with the exception of copper, silver, and gold, all metals exhibit continuous absorption of radiation in the ultra-red, visible, and ultra-violet regions. Copper, silver, and gold are characterized by extensive regions of transparency. The absorption of these metals and aluminium, tin, lead, antimony, bismuth, chromium, and manganese has been investigated in the region 700–186 mμ, and the results are discussed. The absorption minima of the metals are apparently related in a simple manner to their electrical conductivities, the latter indicating how firmly or loosely the conducting electrons are held together.—J. S. G. T.

II.—PROPERTIES OF ALLOYS

(Continued from pp. 69–76.)

The Precipitation-Hardening of Cast Aluminium Alloys. Anon. (*Z. ges. Giesserei-Praxis: Das Metall*, 1933, 54, 531–532).—Precipitation-hardening of copper-aluminium alloys is effected by annealing them for some time at 130°–150° C. after quenching; ageing at the usual room temperature is not effective. The magnesium-silicon-aluminium alloys can be hardened at room temperature, but more rapidly by artificial ageing (annealing at 130°–150° C.). Details of ageing individual alloys of this last class are given, and the mechanical properties of sand- and chill-cast β- and γ-Silumin and the copper 4, silicon 2% alloys are described.—J. H. W.

***On the Alloys of Gallium with Aluminium.** N. A. Puschin and V. Stajič (*Z. anorg. Chem.*, 1933, 216, 26–28).—Thermal investigation reveals three compounds: Al₃Ga, AlGa (melting without decomposition at 467° C. and having a transformation point at 447° C.), and AlGa₂. Aluminium and Al₃Ga form a eutectic at about 39% gallium, and at 425° C. AlGa and AlGa₂ are formed by peritectic reactions at 374° and 280° C., respectively. The melting point of gallium (29.9° C.) is not appreciably lowered by aluminium.—M. H.

***The Influence of Aluminium and Cobalt on the Miscibility Gap of the Iron-Copper System in the Solid State.** F. Roll (*Z. anorg. Chem.*, 1933, 216, 133–137).—The limit of solid solubility of copper in iron-rich iron-aluminium and iron-cobalt alloys containing about 1.5% carbon has been determined micrographically. The solid solubility of copper in iron is increased by 10, 20, and

30% aluminium to about 6, 14, and 24%, respectively, and by 10, 20, and 30% cobalt to about 4, 7, and 9.5%, respectively.—M. H.

Rational Use of "Aluminium-Bronze" by Taking into Consideration Solidification, Hot-Working, and Internal Stresses. C. H. Meigh (*J. Trans. Junior Inst. Eng.*, 1933, 43, 42-49; and (summary) *Found. Trade J.*, 1932, 47, 234-235).—To ensure the full advantage of the special qualities of "aluminium-bronze" there should be rational conceptions of design. The $\alpha + \beta$ alloys are those principally considered, especially with regard to the very short interval of solidification and the contraction experienced during this process. The first phenomenon is often used to counteract the second. This is illustrated by practical examples. The arguments put forward should be particularly useful to the designer and draughtsman.—W. A. C. N.

Ordinary "Aluminium-Bronzes." Properties and Uses. L. Guillet (*Cuivre et Laiton*, 1933, 6, 543-544).—A résumé of the properties and commercial uses of the principal "aluminium-bronzes." The influence of aluminium in increasing quantities up to the maximum of 12% for industrial purposes is studied.—W. A. C. N.

Report of Committee A-10 [of A.S.T.M.] on Iron-Chromium, Iron-Chromium-Nickel, and Related Alloys. Jerome Strauss and H. D. Newell (*Proc. Amer. Soc. Test. Mat.*, 1933, 33, (I), 176-177).—See *J. Inst. Metals*, 1933, 53, 491.—S. G.

***Age-Hardenable Aluminium-Iron-Nickel-Copper Alloys.** E. Vaders (*Z. Metallkunde*, 1933, 25, 291).—Copper-nickel alloys with about 5% aluminium can be hardened by quenching from 900° C. and subsequent annealing at 450°-700° C. The valuable properties of these alloys are still further improved by addition of up to 20% iron, possibly owing to the fact that the solubility of aluminium in copper-nickel is increased. A hardened alloy with copper 86, nickel 10, and aluminium 4% has a tensile strength of 86.8 kg./mm.² and an elongation of 10%; on addition of 10% iron these values become 99.7 kg./mm.² and 8.3%, respectively. These alloys can be readily rolled cold and have a high strength, plasticity, and resistance to corrosion and heat. With a suitable combination of cold-rolling and age-hardening a tensile strength of 140 kg./mm.² with an elongation of 2-3% and a Brinell hardness of 350 can be obtained.—M. H.

Beryllium-Copper Alloys: Their Manufacture and Heat-Treatment. Edwin F. Cone (*Iron Age*, 1933, 132, (6), 14-16, 66).—Describes the manufacture, heat-treatment, physical and mechanical properties, and micro-structure of copper-beryllium alloys containing 1.5, 2, and 2.5% beryllium. These alloys are usually made from a "master alloy," called Cuber, containing 12.5% of beryllium, and they belong to the precipitation-hardening group of alloys. The applications of a nickel-beryllium "master alloy" containing 12.5% of beryllium are also given. Cf. *J. Inst. Metals*, 1933, 53, 717.—J. H. W.

Special Properties and Applications of Beryllium-Copper Alloys. Edwin F. Cone (*Iron Age*, 1933, 132, (10), 18-19, 66).—The mechanical properties of beryllium-copper alloys containing 1.85 to 2.35-2.46% beryllium have been determined after various heat-treatments, and the applications to which these alloys lend themselves are discussed. Cf. *J. Inst. Metals*, 1933, 53, 717.—J. H. W.

Progress in Beryllium-Copper Alloys. Anon. (*Amer. Metal Market*, 1933, 40, (96), 2, 6).—An account of some commercial standard beryllium-copper alloys, followed by an abstract of a paper by H. J. Noble. See *J. Inst. Metals*, 1933, 53, 344.—P. M. C. R.

***The Modulus of Elasticity of the α -Bronzes in the Annealed Condition.** Léon Guillet, Jr. (*Génie civil*, 1933, 103, 578).—See *Met. Abs.*, this volume, p. 70.—W. P. R.

*Investigations on the Equilibrium Relations of Heavily Alloyed Bronzes.

III.—The Copper-Rich Copper-Manganese-Tin Alloys. J. Verö (*Bányamérnöki és Erdőmérnöki Főiskola bányászati és kohászati osztályának Közleményeiből*; *Mitt. berg. hütt. Abt. kg. ung. Hochschule für Berg- u. Forstwesen zu Sopron*, 1933, 5, (Reprint), 28 pp.).—[In German with English summary.]—The ternary system copper-tin-manganese has been investigated by thermal analysis and micrographical examination up to 15% manganese and from the copper corner to the quasi-binary section manganese- Cu_3Sn . The results are shown in a series of equilibrium diagrams for constant manganese contents, and space models of the solidification equilibria and transformations in the solid state are given together with photographs of characteristic structures of the manganese-rich alloys. Addition of manganese to bronze reduces the solubility of tin in the α -phase; with more than 4% manganese (limit of solubility in α - and in β -tin-copper) the appearance and transformations of all bronzes are changed, the β -phase being entirely suppressed, together with all its reactions. A new phase, designated "X," appears in the microstructures when 5% or more manganese is present; this phase is formed only in the solid state by separation from the γ -phase on cooling. The appearance of the $(\alpha + \delta)$ -eutectoid is considerably altered by the presence of much X, and, with 10% manganese, is characteristic of an entirely new eutectoid, although such an eutectoid cannot represent true equilibrium, since it appears only when X is formed from the $(\alpha + \gamma)$ -state and never when it is formed from pure γ . In the latter case the structure of alloys which have been slowly cooled consists of large globular aggregates of X-crystals distributed throughout a ground-mass of the ordinary binary bronze constituents; this structure is particularly well marked in the alloy with 10% manganese and 27% tin, whereas the slowly cooled alloy with 15% manganese and 17.5% tin has a characteristic pearlitic structure of the $\alpha + \delta + X$ pseudo-eutectoid.—A. R. P.

*The Copper-Rich Alloys of the Copper-Nickel-Tin System. John T. Eash and Clair Upthegrove (*Amer. Inst. Min. Met. Eng. Preprint*, 1932).—The equilibrium relationships existing in the copper-rich alloys of the copper-nickel-tin system have been investigated. The α -phase boundary was redetermined for alloys containing from 0 to 20% nickel, together with the liquidus and solidus temperatures above that field. The equilibrium conditions existing in alloys exceeding the α -phase containing up to 31% tin and 5% nickel were investigated. The addition of nickel to copper-tin alloys decreases the solubility of tin in the α -phase. The solubility of tin diminishes also as the temperature is lowered. The $\alpha + \delta$ eutectoid which occurs in copper-tin alloys is replaced by either θ -phase or the δ' -phase when nickel is added in amounts above 1%. The θ -phase is always homogeneous. The second new phase may be homogeneous, or it may be in the form of an $\alpha + \delta'$ eutectoid, depending on the rate of cooling of the alloy. The γ inversion to $\alpha + \delta$ or to $\alpha + \delta'$ when nickel is present is raised to higher tin contents as the amount of nickel is increased.—S. G.

Special Bronzes. Anon. (*Metallbörse*, 1933, 23, 279-280, 317-318).—An alphabetical list of special bronzes with their composition.—A. R. P.

*On the Influence of the β -Constituent upon the Properties of 63 : 37 Brass. J. Verö (*Bányamérnöki és Erdőmérnöki Főiskola bányászati és kohászati osztályának Közleményeiből*; *Mitt. berg. hütt. Abt. kg. ung. Hochschule für Berg- u. Forstwesen zu Sopron*, 1933, 5, (Reprint), 7 pp.).—[In English.] Annealing of 63 : 37 brass at 650° C. or above results in the separation of β from the homogeneous α -phase stable at lower temperatures; this separation reduces the resistance of the alloy to corrosion, especially by chloride solutions, and also reduces the elongation to an extent which is proportional to the amount of β which has separated. The other mechanical properties are affected to a greater or lesser extent, but no regularity between the values and the proportion of β present has been discovered.—A. R. P.

***Influence of the Mixture on the Mechanical Properties of Commercial Rolled 63 : 37 Brass.** O. Rittich (*Mezinárodní Sjezd Slevářenský, Praha (Internat. Foundry Congress, Prague)*, 1933, 363-370 [in Czech]; 371-373 [in French]).—Addition of brass scrap or of 0.1% phosphorus to new brass melts made from electrolytic zinc and copper increases the tensile strength, but reduces the elongation and Erichsen value of rolled sheet. Phosphorus retards the annealing process and increases the brittleness on hot-rolling, but renders the metal less sensitive to overheating. Pure 63 : 37 brass tends to become very coarse-grained on annealing, but this may be prevented by small additions of phosphorus. Arsenic is a particularly deleterious impurity, since it reduces markedly the capacity of the metal to be hot-rolled.—A. R. P.

***Some Effects of Internal Stress on Properties of Drawn Brass Tubes.** D. K. Crampton (*Amer. Inst. Min. Met. Eng. Preprint*, 1932).—Young's law does not hold strictly for drawn tubes, but the modulus of elasticity is maximum at zero loads and falls off continuously with increase in stress. Relief-annealed tubes more nearly approach strict proportionality between stress and strain than drawn tubes. An approximate method for comparing stress intensity and distribution in drawn tubes is described. In general, in hollow sunk tubes stresses persist well into the tube wall, whereas in drawn tubes they fall off much more rapidly. A harmful type of stress distribution also is accompanied by high surface stress and *vice versa*. Polycrystalline tubes showed stresses materially higher than identically treated single crystal tubes. The simultaneous increase of hardness of surface layers originally under tension and decrease of those originally under compression is found when stress is released by splitting. Some preliminary work is reported on effective type and degree of reduction on preferred orientation.—S. G.

***The Development of Internal Stresses and Season-Cracking in Cold-Drawn Brass Tubes.** James Fox (*Engineering*, 1933, 136, 375-376).—Experiments were carried out on hollow-sunk tubes and on mandril-drawn tubes. For detecting internal stress in hollow-sunk tubes mercurous nitrate is most suitable, but ammonia is recommended for testing mandril-drawn tubes. In hollow-sunk tubes the liability to season-crack, especially in the smaller diameter tubes, is much more pronounced than in the mandril-drawn tubes. It is essential that "sinking" should be accompanied by reduction in thickness, as the effect of the latter counterbalances the effect of the former. By a proper combination of dies and internal mandrils tubes can be produced without internal longitudinal stresses.—W. P. R.

Silicon-Zinc-Copper Alloys. T. R. Edmund (*Z. ges. Giesserei-Praxis: Das Metall*, 1934, 55, 33-35).—The composition, melting point, methods of casting, and mechanical properties of silicon-zinc-copper alloys, containing approximately copper 71-95, silicon 2-6, zinc 0-27%, cast in green and in dry sand, are described. The industrially important of these alloys are those containing zinc 10-14 and silicon 4-5%. These alloys have the important advantage over the Tombak alloys, which they somewhat resemble, of better hot-working properties.—J. H. W.

Special Brasses. Anon. (*Metallbörse*, 1933, 23, 50-51, 81-82, 113-114).—An alphabetical list of special brasses, with their compositions.—A. R. P.

***The Rate of Diffusion of Some Metals into Gold and Silver.** W. Jost (*Z. physikal. Chem.*, 1933, [B], 21, 158-160).—The rate of diffusion of palladium, platinum, and copper in gold and of palladium in silver between 700° and 1250° C. has been determined by the method previously described (*J. Inst. Metals*, 1932, 50, 339).—v. G.

***Diffusion in Gold-Lead and Silver-Lead Alloys.** W. Seith and A. Keil (*Z. physikal. Chem.*, 1933, [B], 22, 350-358).—Diffusion tests indicate that the solubility of silver in lead is 0.1 atomic-% at 250° C. and 0.12 atomic-% at 270° C.; these results have been confirmed by measurements of the electrical

conductivity. The solubility of gold in lead is 0.03 atomic-% at 170° C. and 0.08 atomic-% at 200° C.; it is concluded that the gold atoms are disposed in the intermediate spaces in the lead lattice.—V. G.

Recent Applications of the B.N.-F. Ternary Alloys of Lead. Kenneth Gray (*J. and Trans. Junior Inst. Eng.*, 1932, 42, 517-528).—A summary of the B.N.-F.M.R.A. Development Report, D. 3. (See *J. Inst. Metals*, 1932, 50, 731).—W. A. C. N.

***The Surface Tension of Liquid Metals. V.—The Surface Tension of the Lead-Tin Alloys.** L. L. Bircumshaw (*Phil. Mag.*, 1934, [vii], 17, 181-191).—The surface tension of 8 alloys of lead and tin over the whole composition range and of pure lead and tin has been determined over the temperature range from just above the freezing-point to 800° C. The surface tension of all the specimens decreases with rise of temperature. Small quantities of lead produce a marked decrease in the surface tension of tin, but relatively large quantities of tin produce only a slight increase in the surface tension of lead. The surface layer of an alloy of eutectic composition may, on certain assumptions, consist of a uni-molecular layer of lead atoms.—J. S. G. T.

†**Elektron.** Miloš Hájek (*Mezinárodní Sjezd Slevárenský, Praha (Internat. Foundry Congress, Prague)*, 1933, 285-292 [in Czech]; 293-298 [in French]).—The production and properties of magnesium are briefly reviewed and an account is given of the development, properties, casting, working, and uses of Elektron.—A. R. P.

***The Ternary Alloys of Magnesium-Zinc-Calcium.** René Paris (*Compt. rend.*, 1933, 197, 1634-1636).—The ternary system magnesium-zinc-calcium has been investigated by thermal analysis and micrographically. The binary systems were first studied by thermal analysis, and certain corrections made in the results of previous workers. In the magnesium-calcium system, the compound was found to have the formula, Mg_2Ca_3 (49.7% of calcium), instead of Mg_4Ca_3 (55% of calcium) as given by Baar. In the calcium-zinc system, the compound Ca_3Zn_2 has been identified, although not observed by Donski, whilst the compound, Ca_2Zn , claimed by him to exist, is stated to be the result of a misinterpretation of the cooling curves. In the system magnesium-zinc, the work of Chadwick and of Hume-Rothery and Rounsefell has been confirmed. The equilibrium diagram has been constructed for the ternary system, a large part corresponding with the deposition of the compound, Mg_2Ca_3 . The ternary compound $Mg_2Zn_3Ca_2$ consists of large polygonal crystals, unattacked by nitric acid, and melting without decomposition at 492° C. These results were confirmed micrographically. As regards their properties, the alloys can be divided into 3 classes: (1) The calcium-rich alloys (from 30% of calcium), oxidizing and disintegrating in moist air; (2) the zinc-rich alloys (from 40% of zinc), only slightly oxidizable, which, owing to the fragility of the compounds which compose them, are hard, brittle, and unworkable; (3) the magnesium-rich alloys, similar to (1), very light, slightly oxidizable, and easy to work. The alloys are for the most part not of a single phase, for the region of the solid solution very rich in magnesium does not contain at ordinary temperatures more than 1% of each of the other constituents.—J. H. W.

†**Nickel and Its Alloys.** W. R. Barclay (*Met. Ind. (Lond.)*, 1934, 44, 155-156; discussion, 156-159).—Abstract of a paper read before the Midland Metallurgical Societies (Birmingham Local Section of the Institute of Metals, Birmingham Metallurgical Society, and Staffordshire Iron and Steel Institute). The advantages and applications, and the melting and casting of ternary alloys of nickel and copper with metals other than zinc are described, and the development of the alloys of nickel and chromium and the use of nickel in austenitic steels are discussed. In the discussion, the questions of the use of nickel-chromium alloys for high-temperature working (e.g. for dies), the

comparative heat and corrosion-resistance of 85% nickel alloys and 22-28% chromium-iron alloys, the deoxidation of cupro-nickel, the corrosion-resistance of nickel alloys, rolling nickel silver, and corrosion by flowing liquids, were raised. In his reply, B. stated that he had never found evidence that a charcoal cover increased the carbon content of nickel alloys, and dealt with the other points raised. He recommended the use of manganese and magnesium, not only for deoxidizing, which may not be necessary, but for desulphurizing and, in the case of manganese, for improving the properties of the alloys.—J. H. W.

***The Non-Existence of a Higher Nickel Carbide.** Jürgen Schmidt (with Eugen Osswald) (*Z. anorg. Chem.*, 1933, 216, 85-98).—Experiments on the carburization of nickel with carbon monoxide at 240°-250° C. have shown that a higher nickel carbide than Ni_3C is not formed. However, nickel dissolves about 6.4% free carbon more than is necessary to form Ni_3C .—M. H.

Report of Committee B-4 [of A.S.T.M.] on Electrical Heating, Electrical Resistance, and Electric Furnace Alloys. Dean Harvey and F. E. Bash (*Proc. Amer. Soc. Test. Mat.*, 1933, 33, (I), 252-257).—See *J. Inst. Metals*, 1933, 53, 493.—S. G.

***Permanent Set in Monel Metal and Austenitic Cast Iron.** J. E. Hurst (*Engineering*, 1933, 136, 429-431).—In connection with the use of the principle of interference or force fits in the assembly of engineering components the capacity of various materials for permanent set has become a matter of primary importance. H. has made determinations by a method based on British Standards Institution specifications Nos. 5004 and 4K6, on samples of "aluminium-bronze," light aluminium alloys, Monel metal, and austenitic cast irons. For both the ferrous and non-ferrous nickel-containing alloys the permanent set values were determined at a stress of 14 tons/in.².—W. P. R.

†Heat- and Acid-Resisting Alloys. J. Ferdinand Kayser (*Found. Trade J.*, 1934, 50, 26-27; discussion, 27-28).—Abstract of a paper read before the Sheffield Local Section of the Institute of British Foundrymen. The earliest references to heat- and acid-resisting alloys are to those of iron and chromium, and later nickel. The best all-round heat-resisting alloy is one containing approximately: nickel 60, chromium 20, silicon 1, manganese 1, and carbon 0.6-0.8%. The carbon greatly assists in the production of sound castings and considerably increases the strength of the material at high temperatures, but more than 1% is liable to cause brittleness. When used for steam-producing plant, the castings should be treated with aluminium to render them immune from sulphur attack. In replying to the discussion, K. stated that manganese and silicon give a good skin to the alloy, but that aluminium was detrimental in this respect. The chromium and nickel must not be regarded as mere addition elements. The type of sand for the mould is not important. He described the method of applying the creep test, and stated that up to 15% of chromium, cast iron gradually becomes harder and more malleable, but that at 20% of chromium it is fairly unworkable; above a critical percentage (25-27%), the metal is easily rolled and machined. These alloys are not brittle at high temperatures, but will not stand up to lead.

—J. H. W.

***The Hall Effect and Some Other Physical Constants of Alloys. II.—The Tin-Bismuth Series of Alloys.** W. Rheinallt Thomas and E. J. Evans (*Phil. Mag.*, 1934, [vii], 17, 65-83).—The resistivity at 0° C. and the temperature coeff. between 0° and 20° C. and 0° and 40° C., the thermoelectric power over the range 0°-40° C., the density at 16° C., and values of the Hall coeff. have been determined for 23 tin-bismuth alloys covering the complete composition range. The curves connecting electrical resistivity, temperature coeff., the thermoelectric power and density with the percentage weight of bismuth

in the alloys exhibit, in the region of low tin content, a well-defined maximum or minimum. In this respect the results agree with those for the lead-bismuth series of alloys (*J. Inst. Metals*, 1933, 53, 493). The resistivity increases slowly and approximately linearly as the percentage weight of bismuth is increased from 0 to 50%, then more rapidly over the range 50–85% of bismuth, and finally very rapidly to a maximum for about 99% of bismuth. Thereafter the resistivity falls very rapidly. These results are in general agreement with those of Bircher. The main feature of the temperature coeff. of composition curve is the well-defined minimum at the composition corresponding with about 98% of bismuth. The thermoelectric power-composition curve has a maximum at a composition corresponding with 94% of bismuth. The density-composition curve shows a sudden increase and fall of density over the composition range 98.5–100% of bismuth, and is almost linear over the range 0–80% of bismuth. A discontinuity in the Hall coeff.-composition curves for magnetic fields of strengths 3096, 5787, and 7661 oersteds occurs at compositions corresponding with 94% of bismuth, 99% of bismuth, 99% of bismuth, respectively. Starting from the bismuth end of the series, the curves rise rapidly to a maximum, and then fall rapidly until the composition 88% of bismuth is reached. For a given magnetic field there are definite compositions giving a zero Hall coeff. Some of the alloys exhibit reversal of sign of the Hall effect.—J. S. G. T.

***The Intermediate Phases of the Iron-Tungsten System.** W. P. Sykes and Kent R. Van Horn (*Amer. Inst. Min. Met. Eng. Preprint*, 1932, 1–15).—This investigation confirms the existence of an intermetallic phase approximating in composition the formula Fe_2W which has been proposed by Arnfelt. Evidence furnished by X-ray patterns, microstructures, and chemical analyses indicates that this phase is formed at about 1040° C. by a peritectoid reaction between Fe_3W_2 and the iron-rich solid solution. Diffraction patterns of these two intermetallic phases isolated by electrolytic solution agree closely with those published by Arnfelt. A series of alloys in the range of composition between 80 and 90% tungsten was treated in an attempt to form the X-phase reported recently by Takeda. No indication of such a phase was observed in either the microstructures or the diffraction patterns.—S. G.

***Electrical Conductivity and Equilibrium Diagram of Binary Alloys. VIII.—The System Lithium-Zinc.** G. Grube and H. Vosskübler (*Z. anorg. Chem.*, 1933, 215, 211–224).—See *J. Inst. Metals*, 1933, 53, 72. The equilibrium diagram has been established by thermal and resistance methods. The liquidus consists of 5 branches corresponding with the crystallization of 5 series of solid solutions: α , 0–5; β , 5–20; γ , 20–28.5%; δ , 28.5–95.5; and ϵ , 95.5–100 atomic-% lithium. The δ -phase shows a maximum melting point of 520° C. at 40 atomic-% lithium (Li_2Zn_3). Transformations take place in the β , γ , and δ solid solutions.—M. H.

†**Temperature Coefficient of the Elastic Moduli of Spring Materials Used in Instrument Design.** W. G. Brombacher (*Rev. Sci. Instruments*, 1933, [N.S.], 4, 688–692).—A summary of values obtained by different observers of the temperature coeff. of Young's modulus and the modulus of rigidity of aluminium, "beryllium-bronze," brass, copper-silver alloy, Duralumin, Monel metal, nickel-brass, nickel-chromium, phosphor-bronze, tungsten, fused quartz, and various steels, is given.—J. S. G. T.

Special Alloys. Anon. (*Z. ges. Giesserei-Praxis: Das Metall*, 1933, 54, 534; 1934, 55, 16).—The composition, preparation, and properties of some special alloys are described. Cf. *J. Inst. Metals*, 1933, 53, 698.—J. H. W.

†**Ternary Alloys.** Edwin Gregory (*Met. Ind. (Lond.)*, 1933, 43, 319–322, 349–352, 371–374, 398–402).—Long abstract of a short course of lectures delivered at the Department of Applied Science, University of Sheffield. Although 3-dimension diagrams more completely show the phase changes

with temperature of ternary alloys, they are difficult and laborious to construct, and, in most cases, all that is required can be shown in plane diagrams. The construction of such diagrams is explained.—J. H. W.

†**Age-Hardening.** — (*Metallurgist* (Suppt. to *Engineer*), 1933, 9, 66).—A discussion of nomenclature relating to the process.—R. G.

III.—STRUCTURE

(Metallography; Macrography; Crystal Structure.)

(Continued from pp. 76–78.)

Report of Committee E-4 [of A.S.T.M.] on Metallography. C. H. Davis and O. E. Harder (*Proc. Amer. Soc. Test. Mat.*, 1933, 33, (I), 489–491).—See *J. Inst. Metals*, 1933, 53, 440.—S. G.

†**Mechanism and Metallurgy.** L. B. Hunt (*Metallurgist* (Suppt. to *Engineer*), 1933, 9, 78–79).—Some remarks on the progressive development of metallurgical hypotheses on mechanistic lines of thought.—R. G.

Preparation and Etching of Galvanized Wires for Metallographic Observation. L. Hajda and S. Popofe (*Chim. et Ind.*, 1933, Special Number (June), 700–704).—The necessary conditions for good work are the fixation of the cross-section in ebonite, polishing by magnesia suspended in denatured alcohol, and etching by prolonged use of Kourbatoff's reagent. The latter consists of a solution of 4% nitric acid in acetic anhydride, 1 part, and a mixture of methyl, ethyl, and isoamyl alcohols in equal volumes, 10 parts.—W. N.

The Metallographic Examination of Welds. J. D. Jevons and M. A. Wheeler (*Welding J.*, 1933, 30, 166–172; discussion, 172–174).—An elementary discussion of metallic structure is followed by a review of typical weld defects (chiefly steel) as revealed by metallographic examination. This method of investigation is recommended as the best for routine control of welding.

—H. W. G. H.

Ingot Structure. S. L. Archbutt (*Light Metals Research*, 1933, 2, (36), 16–17).—A report of the Chairman's address to the London Local Section of the Institute of Metals, and of the subsequent discussion.—J. C. C.

The Heat-Treatment of "Aluminium-Bronze" Components. P. Mabb (*Machinery* (Lond.), 1933, 43, 39–42).—An account of the effects of heat-treatment on the structure and properties of "aluminium-bronze" containing 10–12% aluminium.—J. C. C.

***The Application of the Radioactive Lead Isotope Thorium B to the Solution of Metallurgical Problems.** G. Tammann and G. Bandel (*Z. Metallkunde*, 1933, 25, 153–156, 207–209).—Radiograms (produced by laying a plane specimen on a photographic plate) show that at least $10^{-6}\%$ of thorium B is soluble in lead, thallium, magnesium, and cadmium (only after heat-treatment), but insoluble in bismuth, tin, antimony, silver, gold, copper, nickel, and zinc in which it segregates along the grain-boundaries. As little as $10^{-11}\%$ of thorium B can still be detected in radiograms, whereas the lower limit of detectability by the microscope is about 0.1%. On adding thorium B to iron containing oxide, sulphide, or slag or to aluminium containing oxide it separates with these inclusions on crystallization, and thus makes them visible in the radiogram. On shaking molten aluminium or zinc containing thorium B with liquid lead, bismuth, or thallium the thorium B almost completely passes into these metals. When an alloy containing thorium B undergoes a transformation in the solid state the radiogram shows the primary (crystallization) structure, whereas the etched specimen shows the real structure under the microscope. When, however, no change in the structure occurs ($\beta \rightleftharpoons \beta'$ transformation in brass, transformation in AuCu_3), radiogram and photomicrograph show identical structures. Radiograms of

rolled and recrystallized cadmium, tin, and zinc show the rolling structure. Further examples are given.—M. H.

Grain-Size in Relation to Cold-Working. A. L. Molineux. J. D. Jevons. H. Davies. — Williams. — Lloyd. Maurice Cook. — Pinkerton. — Miller. T. B. Crowe. — Wiggins (*Met. Ind. (Lond.)*, 1933, 43, 609-612, 634).—A report of an open discussion before the Midland Metallurgical Societies (Birmingham Local Section of the Institute of Metals, Birmingham Metallurgical Society, and Staffordshire Iron and Steel Institute). —J. H. W.

***The Crystal Structure of NdAl.** Charles W. Stillwell and Elmer E. Jukkola (*J. Amer. Chem. Soc.*, 1934, 56, 56-57).—From X-ray diffraction data, the compound NdAl was found to possess the β -brass type of structure ($a_0 = 3.73 \pm 0.01$ Å). The ratio of valence electrons to the number of atoms is 3:2 if the valence of the transition element is assumed to be zero (as in CoAl, NiAl, FeAl, &c.).—R. G.

***X-Ray Study of Aluminium-Zinc Alloys.** E. A. Owen and John Iball (*Phil. Mag.*, 1934, [vii], 17, 433-457).—An account is given of a preliminary survey of the aluminium-zinc system, in which alloys covering a wide range of composition have been examined by the powder-spectrum method. Only alloys below the eutectoid transformation temperature could be investigated by quenching from the desired temperature. The results obtained with these alloys showed that at 250° C. the system comprises the following regions: (1) α -phase (close-packed hexagonal structure) consisting of alloys containing less than about 2% of aluminium by weight; the atomic volume of the α -phase alloys changes from 15.109 Å. for pure zinc to 15.164 Å. for the alloy saturated with aluminium; (2) ($\alpha + \gamma$) region extending from about 2% to 80% of aluminium; (3) γ -phase (face-centred cubic structure) consisting of alloys containing more than 80% of aluminium; the parameter of the γ -phase changes from 4.0406 Å. for pure aluminium to 4.0345 Å. for an alloy containing 80% of aluminium. The eutectoid transformation temperature was found to lie between 300° C. and 310° C., which is higher than the results given by other investigators. X-ray spectrum photographs taken at high temperatures show that the β -phase is a solid solution having a face-centred cubic structure. At 375° C. it extends from 19 to 45% of aluminium; the corresponding crystal parameters are 4.016 Å. and 4.058 Å. In the ($\beta + \gamma$) region two face-centred cubic lattices of different parameters co-exist. At the higher temperatures (up to 450° C.) the parameters of the γ -phase alloys indicate a much smaller range of solubility of zinc in aluminium than that given in most of the thermal diagrams hitherto published. The results altogether closely resemble those due to Hanson and Gayler and to Tanabe for alloys quenched from high temperatures in regions of the equilibrium diagram removed from the β -region, but there seem to be definite departures from these diagrams when the alloys are examined at high temperatures.—J. S. G. T.

***Crystal Structure and Electrical Properties. III.—Lattice Structure and the [Electrical] Conductivity of Bismuth Single Crystals Subjected to Longitudinal Magnetization.** O. Stierstadt (*Z. Physik*, 1933, 85, 697-707).—Just as in the case of transverse magnetization of bismuth single crystals (see *Met. Abs.*, this volume, p. 77) it is shown that details of the lattice structure can be derived from measurements of the electrical conductivity of bismuth single crystals in longitudinal magnetic fields.—J. S. G. T.

***On the Crystal Structure of Borides of the Type MeB_6 .** F. Laves (*Z. physikal. Chem.*, 1933, [B], 22, 114-116).—The lattice structure of metal borides determined by von Stackelberg and Neumann (*J. Inst. Metals*, 1933, 53, 189) can be explained on the assumption that it consists of a framework of boron atoms in which the gaps are filled by metal atoms. An error in the calculations of von S. and N. is corrected.—v. G.

***A Study of Segregate Structures in Copper-Tin and Silver-Zinc Alloys.** Dana W. Smith (*Amer. Inst. Min. Met. Eng. Preprint*, 1932).—Structures resulting from segregation of the α -phases from the respective β -phases of the systems copper-tin and silver-zinc were investigated to determine if they were analogous to those obtained by Mehl and Marzke in the systems copper-zinc and copper-aluminium. A copper-tin alloy containing 74.92% (by weight) of copper, balance tin, and a silver-zinc alloy containing 67.76% (by weight) of silver, balance zinc, were chosen for these investigations. Both of these alloys are entirely in the β -phase fields at elevated temperatures, and on cooling segregate the α -phases. It was shown, in both systems, that the α -phases segregated from the β -phases in the form of needles parallel to [111] directions in the β -phases, and also that in the copper-tin system the α -phase oriented itself so that a {111} plane was parallel to a {110} plane in the β -phase parent solution. It is postulated that the tendency of the α -phase to form needles instead of the more common platelets is to be ascribed to the fact that a similar arrangement of atoms exists along {111} directions in the β -matrix and {110} directions in the α -segregate. In the copper-tin system it was found that a pseudomorphic segregation of the α -phase took place in the form of plates in positions originally occupied by twins in the β -matrix, and that the twinning plane in the β -phase was probably a {133} plane.

—S. G.

***Lattice Structure and Ferromagnetism in Manganese-Aluminium-Copper Alloys. II.—Magnetic and Electrical Investigations.** Otto Heusler (*Z. Elektrochem.*, 1933, 39, 645; discussion, 646).—Read before the Deutsche Bunsen-Gesellschaft. The ferromagnetic manganese-aluminium-copper alloys are characterized by a 3-fold superstructure of the type Cu_3MnAl . For each of the 3 types of atom there is a characteristic partial lattice into which foreign atoms may enter owing to the stoichiometric composition of the alloys and to the mutual exchange of atoms. This entry of foreign atoms in any of the 3 partial lattices lowers the spontaneous magnetism and the Curie point. An explanation of the results based on Sadron's hypothesis (*J. Inst. Metals*, 1933, 53, 8) is put forward.—J. H. W.

***Type and Lattice Structure of Binary Magnesium Compounds.** E. Zintl and E. Husemann (*Z. physikal. Chem.*, 1933, [B], 21, 138-155).— Mg_3Sb_2 is hexagonal, $a = 4.573$ and $c = 7.229$ Å., the magnesium atoms being at the 000; $\frac{1}{3}\frac{2}{3}$ -v; $\frac{2}{3}\frac{1}{3}$ v, and the antimony atoms at $\frac{1}{2}\frac{1}{2}$ u; $\frac{1}{2}\frac{2}{2}$ -u positions, from which $u = 0.235$ and $v = 0.63$. Mg_3Bi_2 has the same type of lattice with $a = 4.666$ and $c = 7.401$ Å. Mg_3P_2 has a complicated cubic lattice with $a = 12.01$ Å. and Mg_3As_2 a similar lattice with $a = 12.33$ Å.—v. G.

***Reflection of Electrons from Liquid Mercury.** [Structure of Liquid Metals.] Robert W. Brode and Edward B. Jordan (*Phys. Rev.*, 1933, [ii], 44, 872-875).—The reflection of electrons from a clean mercury surface has been studied with angles of incidence from 10° to 90° , and velocities from 20 to 70 volts. The bearing of the results on the inner potential of liquid metals, and the nature of the surface are briefly discussed.—W. H.-R.

The Structure of Oxide Films on Nickel. G. D. Preston (*Phil. Mag.*, 1934, [vii], 17, 466-470).—By the method of electron diffraction it is shown that the crystal structure of the film of nickel oxide on nickel sheet is identical with that of NiO having a rock-salt type of lattice of parameter 4.10 Å. approximately.—J. S. G. T.

***On the Electronic Configuration in Metallic Phases.** U. Dehlinger (*Z. physikal. Chem.*, 1933, [B], 22, (1/2), 45-58).—Conclusions are reached as to the electronic configuration of the body-centred cubic compound CuPd from the colour of the alloys of gold, copper, and silver with metals of the iron and platinum groups. An attempt has been made to explain the Hume-Rothery rule.—v. G.

***Lattice-Geometrical Limitations of Slip Planes in Crystals.** H.-G. Sossinka, B. Schmidt, and F. Sauerwald (*Z. Physik*, 1933, 85, 761-771).—It is shown that, in general, the phenomenon of crystal plasticity cannot be interpreted in terms of pure lattice geometry; it must be conceived as a problem in atomic physics.—J. S. G. T.

***Electron Diffraction and the Imperfection of Crystal Surfaces.** L. H. Germer (*Phys. Rev.*, 1933, [ii], 44, 1012-1015).—The X-ray diffraction of fast electrons (0.05 Å.) by etched surfaces of metallic single crystals has been studied for surfaces etched after cutting parallel to the following planes: iron (100) face, nickel (111) face, and tungsten (110) face. Reflections occur accurately at the calculated Bragg angles with no displacement due to refraction, but a given reflection is found when the glancing angle differs considerably (as much as 1° in some cases) from the calculated Bragg value, so that several Bragg orders occur simultaneously. The same effect is found in the diffraction of X-rays, but to a much smaller extent. The values obtained in electron diffraction are regarded as applying to projecting surface metal only, and suggest that there is a much greater degree of imperfection, or lack of alignment at the surface than within the crystal. Even molybdenum K α radiation is probably not sufficiently penetrating to give the true characteristics of the interior.—W. H.-R.

IV.—CORROSION

(Continued from pp. 78-81.)

***On the Behaviour of Some Light Alloys Towards Corrosion.** J. Cournot, M. Chausain, and H. Fournier (*Compt. rend.*, 1934, 198, 85-87).—The light aluminium alloys containing relatively large amounts of magnesium and no copper can be divided into 2 main classes: (1) those containing 6-9% of magnesium and a little manganese and silicon, and (2) those containing magnesium 2-3, manganese 1-3, antimony 0.2-0.5%, and a little silicon. The resistance of these alloys to sea-water has been investigated by immersion and alternate immersion tests at ordinary temperatures for 25 days. A first series of tests on rolled alloys: an alloy containing magnesium 9.05, manganese 0.37, and silicon 0.21%, an ordinary Duralumin, and a special nickel-chromium Duralumin, gave mean losses of weight of 15.00, 23.15, and 16.40 gm./m.², respectively. The corroded appearance was very different, the Duralumins being attacked equally all over, whilst the other alloy was attacked especially strongly in the middle of the specimens. A second series of tests on drawn alloys, one of the first class and 2 of the second, gave mean losses of weight of 43.10, 29.25, and 28.25 gm./m.², respectively, the corroded appearance being similar in the 3 cases. Thus alloys containing slightly more magnesium than the special Duralumin are still far from being unattacked, although E. Herzog and G. Chaudron (*J. Inst. Metals*, 1933, 53, 499) have shown that both the composition and states of the alloys might be improved. The alloys of the second class are distinctly more resistant to corrosion than the ordinary alloys, but their mechanical properties are lower. Of 2 such alloys containing magnesium 8.85 and 9.18, silicon 0.04 and 0.06, manganese 0.03 and 0.34%, and copper nil, respectively, the latter showed less than half the loss in weight of the former, owing to its manganese content, as indicated by H. and C. (*loc. cit.*). It is therefore concluded that there are in the first class alloys of some importance for marine purposes, but the resistance of which to corrosion varies considerably for small differences in composition, and their preparation requires great care and very pure materials. It is not overlooked that there are other important factors which must be taken into account in considering the question as a whole.—J. H. W.

The Dissolution of Aluminium in Alkaline Solutions. G. Schikorr (*Mitt. Material., Sonderheft 22*, 1933, 16-22).—Reprinted from *Z. Elektrochem.*, 1931, 37, 610-613. See *J. Inst. Metals*, 1932, 50, 24.—S. G.

On the Action on Aluminium and Its Alloys of Fuels Containing Alcohol. O. Bauer and G. Schikorr (*Mitt. Material., Sonderheft 22*, 1933, 25-32).—Reprinted from *Automobiltech. Zeit.*, 1932, 35, 583-589. See *J. Inst. Metals*, 1933, 53, 242.—S. G.

Detection and Determination of Copper in Fresh Waters. Their Attack on Copper Water Pipes. J. Golse (*Bull. Trav. Soc. pharm. Bordeaux*, 1933, 71, 30-41; *Chem. Zentr.*, 1933, 104, II, 2428).—Most spring and river waters contain minute traces of copper of the order of 0.001-0.01 mg. per litre. When such water passes through copper pipes or cocks the quantity of dissolved copper may exceed 0.1 mg./litre; this additional copper is derived from the action of dissolved carbon dioxide and possibly from electrolytic action between the copper and lead or solder with which it is in contact. Since many foods contain much more copper than is likely to be found in any potable water, even after prolonged contact with copper tubes or copper, it follows that these are suitable for handling domestic water supplies without fear of danger to health.—A. R. P.

On the Influence of Methyl Alcohol on Elektron. J. Formánek (*Chem. Obzor*, 1933, 8, 81-83; *Chem. Zentr.*, 1933, 104, II, 2323).—Pure absolute methyl alcohol is without action on Elektron (containing aluminium, zinc, manganese, and copper) which has been freed from grease by washing in alcohol and ether. On the other hand, wood alcohol containing higher alcohols, aldehydes, &c., and synthetic methanol (which contains traces of arsenic and sulphur) rapidly cause corrosion of the alloy with the production of carbonates and hydroxides of its constituents. Addition of 0.5% of acetone retards corrosion, and admixture with an equal volume of ethyl alcohol entirely prevents it. None of the above grades of methyl alcohol has any action on Silumin.—A. R. P.

***Corrosion-Fatigue of Nickel-Coated Mild Steel.** Anon. (*Machinery (Lond.)*, 1933, 43, 144).—Tests carried out at the National Physical Laboratory indicate that the corrosion-fatigue endurance limit (20×10^6 cycles) of specimens of mild steel tested in a spray of 3% sodium chloride solution is raised from ± 7.3 tons/in.² to ± 12.2 tons/in.² by the application of a nickel coating by the Fescol process.—J. C. C.

***Corrosion Investigations on the Tin-Silver Amalgams.** N. Brecht (*Z. Elektrochem.*, 1933, 39, 927-935).—The behaviour of different tin-silver amalgams, chiefly those used as dental amalgams, towards corrosion and the mechanism of the process have been investigated. The loss in weight as a measure of the corrosion in the 3-phase region tin-mercury solid solution-Ag₃Sn-(Ag₃Hg₄ + 0.44% tin), shows that corrosion in *N/10* solutions of perchloric acid, citric acid, sodium hydroxide, and sodium chloride is independent of the composition. Mercury-poor, and therefore porous, specimens lost more weight than mercury-rich ones. The corrosion of these amalgams cannot be attributed to the effect of local elements, but to the instability of the pure phases to the solution concerned. The potential of all amalgams in this region is that of the tin-mercury solid solution, which is equal to that of tin. It is therefore affected by the corrosion of the solid solution. By anodic polarization, the tin goes into solution in *N/10* perchloric acid as Sn⁺⁺ up to a current density of 15 m.amp./cm.². In the other solutions, the tin also goes into solution in the divalent state up to 3 m.amp./cm.². At higher current densities, passivity occurs, which the solution of the tin hinders, and finally leads to the evolution of oxygen and chlorine. The attack can be measured by the accelerating effect of the anodic corrosion; the more porous the amalgam is made, the deeper the penetration. This agrees with the data on

loss of weight, and anodic corrosion thus provides a new means of investigating the structure of different amalgams.—J. H. W.

***Effect of Impurities on the Corrosion of Zinc.** O. Bauer and P. Zunker (*Z. Metallkunde*, 1933, 25, 282–284).—The influence of additions (a) of 0.1–1.0% lead to electrolytic zinc (99.98%), (b) of 0.1–1.0% copper, antimony, iron to refined zinc containing 1.12% lead and 0.11% cadmium, on the rate of corrosion in 1% sodium chloride solution during 16 weeks has been investigated. The loss in weight of electrolytic zinc is 0.72 gm./m.²/day; this is increased by 0.1, 0.3, 0.5, 0.7, 0.9, and 1.0% lead to 1.14, 1.12, 0.86, 0.86, 1.16, and 1.21, respectively. Addition of 0.1–0.3% antimony, iron, or copper increases, in the order named, the loss in weight of refined zinc (0.76). With still higher additions the loss in weight either decreases (antimony) or remains practically constant. The hydrogen evolved in 0.1N-hydrochloric acid is almost the same for electrolytic zinc and refined zinc, but less for alloys of the former with 0.3–1.0% lead.—M. H.

***The Corrosion of Zinc in Chloride Solutions.** C. W. Borgmann and U. R. Evans (*Electrochem. Soc. Preprint*, 1934, April, 39–60).—The initial rate of corrosion of zinc sheet half immersed in potassium chloride solution rises steadily with the concentration up to 3N, whereas that of iron under similar conditions decreases at high concentrations; this difference in behaviour and the apparent discrepancy of these results with those of Bengough on totally immersed zinc is ascribed to the greater ease of access of oxygen with half-immersed sheet. With round zinc rods half immersed in potassium chloride solution the initial rate of corrosion reaches a maximum in 1N-solution, showing that the round shape is less suitable for oxygen replenishment than flat sheet. Rods of very pure zinc are only slightly more slowly corroded than those of ordinary pure zinc in 0.1N-potassium chloride solution; addition of copper or iron slightly accelerates, whereas aluminium slightly retards, the initial rate of attack, but the effects in all cases are much smaller than in acid solutions. Zinc sheet cannot be rendered absolutely immune from attack in distilled or in sea-water by reducing the iron or lead content, by protecting the edges, or by avoiding a rough surface; and the steady rate of attack on half-immersed zinc is not permanently affected by temporary changes in temperature, by vibration, or by saturation of the solution with oxygen. The causes of the "scatter" observed in duplicate experiments are discussed at length.—A. R. P.

Report of Committee B-3 [of A.S.T.M.] on Corrosion of Non-Ferrous Metals and Alloys. T. S. Fuller and Sam Tour (*Proc. Amer. Soc. Test. Mat.*, 1933, 33, (I), 232–233).—See *J. Inst. Metals*, 1933, 53, 500.—S. G.

Contribution to Corrosion Problems in Ice-Producers. Albrecht Steinbach (*Z. ges. Kälte-Ind.*, 1933, 40, 104–108, 128–130; *Chem. Zentr.*, 1933, 104, II, 2449).—In ice-plants utilizing brines and chloride liquors as refrigerants lead-coated iron is the best material for resisting their corrosive action; galvanized iron, on the other hand, is rapidly disintegrated.

—A. R. P.

Solubility of Some Metals and Technical Alloys in Zinc Chloride Solution. W. Kuczynski and M. H. Weiss (*Przemysł Chem.*, 1933, 17, 175–178; *Chem. Zentr.*, 1933, 104, II, 2322).—The rate of corrosion of copper, lead, Avesta metal, and several special steels in 24 and 60% zinc chloride solution (0.1 and 0.2N with respect to hydrochloric acid respectively) has been determined at 85–90° C. and at the boiling point of the solution. In the more dilute solution Avesta metal is the most resistant, but in the more concentrated solution copper behaves better than this alloy. Lead is the most rapidly corroded of all the metals tested; the rate of attack is increased by the presence of nitrates or chlorates and decreased by the presence of organic colloids, such as starch or gelatin.—A. R. P.

Corrosion of Metals in Salt Solutions and Sea-Water. G. D. Bengough (*Proc. Chem. Eng. Group, Soc. Chem. Ind.*, 1932, 14, 110-140).—See *J. Inst. Metals*, 1933, 53, 704.—S. G.

***On the Dissolution of Metals in Acids.** Maria Schunkert (*Z. physikal. Chem.*, 1933, [A], 157, 19-28).—The rate of dissolution of iron and zinc in dilute and concentrated hydrochloric acid is reduced by additions of albumin, agar, dextrin, gelatin, casein, starch, or saponin. The strong electrolytes methyl-violet and methylene-blue reduce the rate of dissolution of iron in concentrated sulphuric acid, but increase that of zinc in the dilute acid. The additions deposit only on the dissolving metal, and not on the impurities. Strongly dissociated salts may act as accelerating or inhibiting agents, according to the conditions; they increase the rate of dissolution when, in dilute solution, they increase the conductivity, and hence the current density of the local elements, but they reduce the rate when they decrease the degree of dissociation and when the undissociated molecule is adsorbed in the metal to a considerable extent.—B. Bl.

Report of Sub-Committee VI [of Committee B-3 of A.S.T.M.] on Atmospheric Corrosion of Non-Ferrous Metals and Alloys. William H. Finkeldey (*Proc. Amer. Soc. Test. Mat.*, 1933, 33, (1), 234-252).—See *J. Inst. Metals*, 1933, 53, 500.—S. G.

***Contributions to the Theory of Surface Colouring [of Metals].** Carl Wagner (*Z. physikal. Chem.*, 1933, [B], 21, 25-41).—The rate of formation of oxide, sulphide, and other films on metal surfaces has been derived theoretically from assumptions as regards the nature of the diffusion in the boundary film. The formulæ are in accordance with the practical results of other workers on silver-sulphur and copper-oxygen.—v. G.

Corrosion Velocity and Corrosion Probability. U. R. Evans, R. B. Mears, and P. E. Queneau (*Engineering*, 1933, 136, 689-690).—A letter to the Editor. The difference between velocity and probability of corrosion should be carefully distinguished. A statement that a certain set of conditions are highly corrosive may mean (1) the risk of corrosion commencing is great, or (2) that corrosion, once started, will proceed rapidly. A factor causing (1) does not necessarily also cause (2). The repression of attack by increasing oxygen concentration is quite surprising, especially in the case of tests made on steel.—W. P. R.

Corrosion and Co-ordination. H. L. Riley (*Proc. Roy. Soc.*, 1934, [A], 143, 399-410).—The rates of solution of copper in aqueous solutions of the sodium salts of oxalic, malonic, succinic, phthalic, carbonic, acetic, benzoic, citric, tartaric, and salicylic acids are compared with the rates of solution of nickel in the same solutions. The greater corrodibility of copper revealed by the results is attributed to that "chemical" property of copper, which governs its tendency to form sparingly dissociated complex ions. The effects of concentration, acidity, and area are briefly discussed.—J. S. G. T.

†Some Aspects of the Corrosion Problem. Ulick Richardson Evans (*Proc. Inst. Civil Eng.*, 1932, 234, 445-490).—In the James Forrest Lecture, 1932, the problem of corrosion is discussed as it affects the engineer, and reference is made to the researches being carried out both at home and abroad in the theory and practice of metal-wastage. Very full consideration is then given to the principles of corrosion and to its prevention by the formation of thin protective films. Prevention of corrosion by water-treatment using suitable "inhibitive chemicals" is also discussed, as is also protection by paint and by deposits of a second metal, and it is stated that the choice of the protective system to be adopted must depend largely on the service conditions to be withstood.—J. W. D.

V.—PROTECTION

(Other than Electrodeposition.)

(Continued from pp. 81–83.)

***Electrochemical Oxidation, and Protection of Iron and Duralumin in Aerated Aqueous Solutions.** Eugène Herzog (*Publ. Sci. Tech. Ministère de l'Air (France)*, No. 19, 1933, 1–88).—Chapter I deals briefly with old and new theories of rusting of iron and electrochemical theory of corrosion. Special mention is made of the differential aeration effect demonstrated by Evans. Chapters II and III are devoted to experimental work on corrosion cells. The variation in current with variation in area of anode is studied in cells having electrodes of different materials. Reducing the area of the anode to one three-hundredth of the original caused only a 75% reduction in the current. Increase in current with increase of oxygen concentration due to cathodic depolarization was observed with the aid of specially designed apparatus, in which an atmosphere of oxygen could be maintained under any desired pressure. The increase of corrosion current with increase of oxygen pressure is rapid at first, and later attains a maximum. Agitation had no effect on the corrosion current, showing that cathodic depolarization is not dependent on mechanical movement. An experimental Evans' cell is described in which the author investigated the behaviour of iron anodes and cathodes in ammonium chloride solution. Special attention is paid to the "starting" of the cells. The influence of ratio of electrode surfaces, of oxygen content of the solution, and of H-ion concentration of the solution are studied. H. states that all the galvanic cells and Evans' cells studied function by reason of oxygen reaching the cathode. Further sections deal with polarization of galvanic cells and Evans' cells by surface films, polarization effects of particular cations and anions, and effect of buffer action. Experiments on the effect of pressure of oxygen above the electrolyte in simple immersion tests, on the effect of position of the samples in the electrolyte, and on the influence of a parchment screen over one of the upper portions of a sample are described. The occurrence of hydrogen peroxide at the cathodic surface in Evans' cells is discussed and correlated on quantitative lines with the theory of formation of H_2O_2 with emission of metallic ions. The concluding chapters deal with the protection of iron and Duralumin against the action of aerated waters, protection by various cations and anions, the separate effects of the different salts present in sea-water, the effect of additions of chromium and nickel to iron, and the influence of additions of zinc and nickel to Duralumin. Special reference is made to mechanical tests of corroded samples, local attack, notch effect, restoration of properties by polishing, local corrosion of Duralumin, intercrystalline corrosion of Duralumin, accelerated corrosion tests of Duralumin, and methods of making corrosion tests.—H. S.

Report of Committee A-5 [of A.S.T.M.] on Corrosion of Iron and Steel. J. H. Gibboney and James Aston (*Proc. Amer. Soc. Test. Mat.*, 1933, 33, (1), 140–143).—See *J. Inst. Metals*, 1933, 53, 503.—S. G.

Report of Sub-Committee V [of Committee A-5 of A.S.T.M.] on Total Immersion Tests. F. B. Olcott (*Proc. Amer. Soc. Test. Mat.*, 1933, 33, (1), 144–146).—See *J. Inst. Metals*, 1933, 53, 504.—S. G.

Report of Sub-Committee VI [of Committee A-5 of A.S.T.M.] on Specifications for Metallic Coated Products. F. F. Farnsworth (*Proc. Amer. Soc. Test. Mat.*, 1933, 33, (1), 147–148).—See *J. Inst. Metals*, 1933, 53, 504.—S. G.

Report of Sub-Committee VIII [of Committee A-5 of A.S.T.M.] on Field Tests of Metallic Coatings. R. F. Passano (*Proc. Amer. Soc. Test. Mat.*, 1933, 33, (1), 149–165).—See *J. Inst. Metals*, 1933, 53, 504.—S. G.

Report of Sub-Committee X [of Committee A-5 of A.S.T.M.] on Embrittlement Investigation. V. F. Hammel and C. S. Trewin (*Proc. Amer. Soc. Test. Mat.*, 1933, 33, (I), 166-169).—See *J. Inst. Metals*, 1933, 53, 504.—S. G.

New Method for Determining the Thickness and Quality of the Zinc Deposits on Galvanized Iron Wires. A. Glazunov (*Chim. et Ind.*, 1933, 29, Special Number (June), 688-690).—The galvanized wire, about 20-30 cm. long, is covered with wax, except for 3-4 cm. in the middle portion, and then immersed vertically in a concentrated zinc sulphate solution. It is made the positive pole in this electrolyte, a cylinder of platinum surrounding the wire being the cathode. The amperage and voltage are recorded. During the anodic solution of the zinc covering, the current and potential remain constant, but when the zinc-iron alloy commences to dissolve the potential rises. Another period of constant voltage follows the solution of the alloy. Knowing the dimensions of the wire, the amperage, and the duration of the trial, the thickness of the pure zinc and zinc-iron layers may be calculated.

—W. A. C. N.

Dross in Metal Ware Galvanizing. I.—Quantities and Percentage. Wallace G. Imhoff (*Amer. Metal Market*, 1933, 40, (176), 3, 6; and *Met. Ind. (Lond.)*, 43, 369-370, 419-421).—Statistics are given showing the relative amounts of zinc put through the galvanizing pots and of dross produced, with various fuels and at different periods in the development of the industry. The type of fuel is found to be almost immaterial. Improved insulation and pyrometric control have reduced the percentage of dross in 15 years from 31.1 to 6.8. The iron content of dross is found to be derived chiefly from residues of pickle salts, and not from the pot as was originally supposed.—P. M. C. R.

***The Characteristics of Sprayed Metal Coatings.—III.** H. Reininger (*Z. Metallkunde*, 1933, 25, 286-288).—Cf. *J. Inst. Metals*, 1933, 53, 247, 310. Cold-deformation by rolling or pressing of sprayed metal coatings results in a closer packing of the particles and in a closer contact with the surface to be protected. The deformation, however, should not be too large, otherwise the coating separates in places from the surface by the action of internal stresses. The adhesion strength is not appreciably increased by cold-deformation.—M. H.

Metallizing with the Spray Pistol. F. Gerber (*Metallbörse*, 1933, 23, 510-511).—An electrically operated pistol for spraying chromium, tungsten, molybdenum, and platinum is described; two wires (1 mm.) of the metal are fed automatically into the pistol and an arc is passed between them using a.c. or d.c. of 30-35 amp. at 40 v. while a current of air is blown through the arc to spray the molten metal on to the object.—A. R. P.

†Pipe Corrosion and Protection. Amos H. Abbott (*Amer. Gas J.*, 1934, 140, (1), 9-11).—The corrosion of iron and steel pipes in soil is discussed. Protective devices, including cathodic protection, are briefly referred to.—J. T.

VI.—ELECTRODEPOSITION

(Continued from pp. 83-85.)

***Electrodeposition of Aluminium from Non-Aqueous Solutions.** R. D. Blue and F. C. Mathers (*Electrochem. Soc. Preprint*, 1934, April, 25-38).—Bright, finely crystalline adherent deposits of aluminium on platinum, copper, steel, and cast iron, but not on magnesium or aluminium, can be obtained from a bath produced by dissolving 30 grm. of aluminium in a mixture of 1 c.c. of bromine, 450 c.c. of ethyl bromide, and 250 c.c. of benzene. Toluene, xylene, β -tetrahydronaphthalene, and kerosene may replace the benzene, and ethyl, methyl, or ethylene chlorides the ethyl bromide. An aluminium anode

is used with a current of 0.9 amp./dm.² at 3 v. Anode efficiency is 80%, cathode efficiency 60–70%, and throwing power up to 25%. By keeping the bath covered, to exclude water vapour as far as possible, it can be operated over long periods without deterioration. Copper-aluminium alloys have been successfully deposited from this type of bath, which appears to have commercial possibilities.—A. R. P.

***The Deposition of Chromium from Solutions of Chromic and Chromous Salts.** Charles Kasper (*U.S. Bur. Stand. J. Research*, 1933, 11, 515–526; *Research Paper No. 604*).—The confusing and apparently contradictory literature on the electrodeposition of chromium from trivalent and bivalent salts was critically examined and pertinent experiments were performed. The main obstacle to obtaining bright deposits at high efficiency is not, as formerly supposed, in keeping the solutions of trivalent chromium violet, i.e. preventing the formation of green undissociated molecular Cr, but in maintaining a low concentration of hydrogen ions and a high concentration of chromium ions in the cathode film. The use of chromous salts or of chromic complexes does not circumvent this difficulty. The chromic acid bath is inherently superior to those containing chromium in the lower valence states.

—S. G.

***The Importance of Bath Temperature in Chromium Electrolytes.** Eugen Werner (*Metallbörse*, 1933, 23, 241–242, 350–351).—The effects of temperature and sulphuric acid content of the bath on the nature of the chromium deposit are discussed. To obtain bright deposits at 35°–45° C. a low sulphuric acid content is necessary, whereas at 17° C. a higher acidity is required. Bright deposits can also be obtained from baths containing phenol and oxalic acid, tungstic acid and sodium bisulphite, sodium silicofluoride or other fluorine derivatives, phosphates, aluminium sulphate, or acetic acid, provided that the temperature and current density are adjusted correctly according to the amount of addition agent present; several examples are given.—A. R. P.

†On the Problem of Chromium Plating. W. Birett (*Maschinenbau*, 1934, 13, 27–29).—The influence of the shape and pre-treatment of the articles on the quality and efficiency of the chromium plate is discussed.—v. G.

Chromium Plating from Ammonium Chromate-Sulphate Baths. Raymond R. Rogers and John F. Conlon (*Trans. Electrochem. Soc.*, 1933, 64, 299–304).—See *J. Inst. Metals*, 1933, 53, 557.—S. G.

Electrodeposition of Cobalt. — (*Met. Ind. (Lond.)*, 1934, 44, 144, 164–166).—Abstract of a *résumé* of the literature of the electrodeposition of cobalt which was published in the form of a Report of the Deloro Research Laboratories on the electrodeposition of nickel, cobalt, and chromium. The relative merits of the 3 metals are discussed in connection with electroplating generally. Nineteen references are given.—J. H. W.

***Microscopic Measurement of Copper and Nickel Plate Thickness on Steel, Brass, and Zinc Die-Castings.** Fred Carl (*Monthly Rev. Amer. Electroplaters' Soc.*, 1933, 20, (2), 17–25; discussion, 25–28).—The method advocated is to apply a thick copper coating to the plate by electrolysis, first in a cyanide, then in an acid sulphate bath, then to make a section, polish and etch it, and finally measure the thickness of the various plated layers under a high-power microscope. Details of the various steps are given.—A. R. P.

***The Effect of Annealing on the Microstructure and Mechanical Properties of Nickel Deposits.** G. E. Gardam and D. J. Macnaughtan (*Trans. Faraday Soc.*, 1933, 29, 755–764; and *J. Electrodepositors' Tech. Soc.*, 1934, 9, 27–36).—Measurements of the hardness, tensile strength, and elongation, and examination of the microstructure of nickel deposits prepared from various solutions of different p_H have been made before, and after, annealing for 4 hrs. at 1000° C. *in vacuo*. The hardness and tensile strength of the unannealed deposits are closely related unless the deposits are faulty,

and the elongation is approximately inversely proportional to the tensile strength. Grain-growth on annealing depends on the original structure and hardness; in deposits produced under conditions favouring co-deposition of basic material considerable restriction of grain-growth on annealing has been observed owing to segregation of non-metallic inclusions which reduce the strength and ductility of the deposits after annealing. All the results obtained thus tend to confirm the theory that the hardness of nickel plates is dependent on the quantity of basic material co-deposited.—A. R. P.

A Century of Progress in Nickel Deposition. W. M. Phillips (*Monthly Rev. Amer. Electroplaters' Soc.*, 1933, 20, (2), 29-33; discussion, 33-34).—A brief review.—A. R. P.

Progress in Electrodeposition, 1933-1934. E. A. Ollard (*Met. Ind. (Lond.)*, 1934, 44, 70-72).—Briefly reviews the progress made during the past year in the electrodeposition of palladium and rhodium. The latter is more efficient and superior in effect, but is more costly. Progress in the electrodeposition of the commoner metals, in anodic oxidation, testing, and standardization is briefly summarized.—J. H. W.

Palladium and Rhodium Plating. A. W. Scott. E. A. Ollard (*Met. Ind. (Lond.)*, 1934, 44, 130-132).—A letter commenting on O.'s review: "Progress in Electrodeposition, 1933-1934" (preceding abstract), and disputing the excessive cost of rhodium plating, having regard to its efficiency and its advantages over palladium plating. In his reply, O. agrees with regard to the excellence of the former, but considers it too expensive for any but small and valuable articles at present.—J. H. W.

***The Electrodeposition of Rhodium.** G. Grube and E. Kesting (*Z. Elektrochem.*, 1933, 39, 948-958).—It is shown qualitatively that a very bright deposit of rhodium is obtained from sulphuric acid, hydrofluosilicic acid, borofluoric acid, perchloric acid, and oxalic acid rhodium baths. All these baths are regenerative by the solution of freshly-prepared rhodium hydroxide. The quantitative deposition of rhodium was investigated by the increase of the current density-potential curves, and the determination of the current efficiency in hydrochloric acid solutions of sodium chloride and rhodium chloride, in solutions of oxalic acid, ammonium rhodium phosphate, rhodium perchlorate, rhodium silico-fluoride and rhodium sulphate, and the effect of the temperature and the excess of the free acid on the conditions of deposition were studied. The deposition took place with very high polarization, so that with relatively low current density the deposition of the metal is accompanied by evolution of hydrogen.—J. H. W.

Electrodeposition of Rhodium. R. H. Atkinson and A. R. Raper (*J. Electrodepositors' Tech. Soc.*, 1934, 9, 77-82; and (summary) *Met. Ind. (Lond.)*, 1934, 44, 191-193; discussion, 193-194).—Previously published work is reviewed. A sulphate solution containing 2 gm. rhodium and 33 c.c. sulphuric acid per litre is recommended, used with platinum anodes at 40° C. and 5 amp./ft.². The following methods of preparing solution from metal are recommended: (i) fusion with acid potassium sulphate; (ii) ignition at red heat of a mixture of metal and sodium chloride or barium chloride in chlorine; (iii) alloying 1 part rhodium with 10 of bismuth and dissolving in nitric acid or *aqua regia*. Cake from (i) or (ii) is dissolved in water and sodium hydroxide added; the hydroxide precipitate is soluble in hydrochloric, sulphuric, or phosphoric acid, but intermediate preparation of ammonium rhodinitrite is advised. 1 litre of solution containing 5 gm. of rhodium as chloride is boiled with 40 gm. sodium nitrite, 3 gm. sodium carbonate are added, the precipitate of bismuth is filtered off, 50 c.c. saturated ammonium chloride solution are added, and the precipitate of rhodinitrite is filtered off. 8.52 gm. are fumed down with 33 c.c. sulphuric acid to make 1 litre of plating solution. Articles are plated 5-15 minutes (1.5-4.5 mg./in.²). Rhodium plating is chiefly used for jewellery and reflectors. The diamond hardness number of the deposit is 600-650.—S. W.

***Plating Stainless Steel.** Joseph Hoefler (*Monthly Rev. Amer. Electroplaters' Soc.*, 1933, 20, (1), 22–26).—To obtain satisfactory adherence of the plate the passive film on the steel must be removed; this is best effected by immersion in 12*N*-hydrochloric acid containing ferric chloride 2 oz. and arsenic trioxide 8 oz./gall. For nickel plating, immersion in concentrated hydrochloric acid is sufficient if the plating is done in a chloride bath, e.g. one containing nickel chloride 10, ammonium chloride 2, and boric acid 3 oz./gall. Good results can also be obtained with a dip in 6*N*-hydrochloric acid containing 16 oz./gall. of nickel chloride and subsequent plating in a bath containing nickel sulphate crystals 28, nickel chloride 7, and boric acid 3 oz./gall. (p_H 2.5, temperature 50° C., current density 35 amp./ft.²). A chromium finish can be applied in any suitable bath to coatings produced in either of the above ways.—A. R. P.

The Application of Electrodeposition to Printing. H. F. Boughay (*J. Electrodepositors' Tech. Soc.*, 1934, 9, 57–76; and (summary) *Met. Ind. (Lond.)*, 1934, 44, 15–16, 141–144).—A review with an extensive bibliography. The chief applications are to relief and intaglio processes. (1) Thick deposits. The factors affecting preparation of copper and nickel electrotypes from wax or metal moulds are reviewed. High rate of deposition and high mechanical properties of copper are necessary. High current density and temperature, violent agitation and solutions containing 1 grm./l. phenol as phenolsulphonic acid are advocated. The solution is not satisfactory until "aged" 400 amp. hrs./gall. For intaglio processes current density copper coatings on ferrous or aluminium cylinders are used. Methods of obtaining an adherent preliminary coat are given, subsequent copper deposition as above. The methods of grinding and polishing to a true cylinder are described. Non-adherent coatings are also used to reduce grinding costs and for the preparation of flat sheet. (2) Thin deposits are used as facings to reduce wear, particularly local wear, e.g. high lights dots in half tones. Methods of nickel and chromium facing are described. Iron facing is almost obsolete, nickel facing is used for lead alloy surfaces, e.g. stereotypes and copper electros, but chromium facing is more satisfactory for the latter and for intaglio; it is almost essential for rotary gravure. Amalgam lithographic processes, e.g. pantone and Renck, use brass or copper plates, coated electrolytically with a thin film of a non-amalgamating metal, e.g. chromium, which is subsequently etched away in the high lights; the base metal is kept amalgamated during printing and rejects ink. (3) Electrolytic etching possesses marked advantages over chemical etching, but is as yet undeveloped. Methods are described. (4) Electrophoretic deposits of rubber offer promise in block-making, but at present will not reproduce fine detail.—S. W.

Control Testing of Metallic Coatings. R. B. Mears (*J. Electrodepositors' Tech. Soc.*, 1933, 9, 43–56; and (summary) *Met. Ind. (Lond.)*, 1933, 43, 517–518, 613–615).—General principles underlying production tests on electroplated and other coatings to ensure satisfactory service are discussed. Tests of specific factors rather than behaviour in accelerated corrosion tests are recommended. Thickness or weight of coating tests are most important, and a table of recommended methods is given, together with new methods for removal of nickel from iron and copper from nickel or iron. Tests for porosity, hardness, wear resistance, adherence, and uniformity are reviewed. A method for the statistical interpretation of the results of tests on samples is outlined in which the fraction defective is plotted, and must not vary beyond calculated limits. An extensive bibliography is included.—S. W.

†The Microscopic Study and Control of Electro-Deposition. A. Portevin and M. Cymboliste (*Metalurgist (Suppt. to Engineer)*, 1933, 9, 87–91).—A full summary of a paper by P. and C. in *Rev. Mét.*, 1933, 30, 323. See *Met. Abs.*, this volume, p. 84.—R. G.

Removal of Electrodeposits (*J. Electrodepositors' Tech. Soc.*, 1933, 9, 37–41).—A general discussion on the intentional removal of old or defective electro-

deposits. Chromium may be removed from nickel or steel by anodic action in sodium hydroxide or carbonate solution; an oxide film is left on nickel and must be removed before re-chromium plating. Dilute hydrochloric acid may also be used. Nickel is removed from steel or brass by anodic action at 150-500 amp./ft.² in 50% sulphuric acid without serious attack on the basis metal. Zinc and cadmium are removed from steel by dilute acid; addition of an inhibitor such as gum tragacanth is advised. Methods for removing fire stains from silver articles are given.—S. W.

Notes on Stray Currents in Plating Baths. Gustaf Soderberg (*Monthly Rev. Amer. Electroplaters' Soc.*, 1933, 20, (1), 26-33).—Causes and prevention of stray currents in metal plating tanks are discussed.—A. R. P.

Methods and Concepts in the Development of Electrodeposition. Leslie B. Hunt (*Met. Ind. (Lond.)*, 1934, 44, 13-15).—A brief review of the theoretical considerations which have guided the development of electrodeposition practice, the present tend of thought and the mechanism of deposition is given.—J. H. W.

Faraday—Electroplating in His Time and To-Day. George B. Hogaboom (*Monthly Rev. Amer. Electroplaters' Soc.*, 1933, 20, (2), 6-16).—A brief review of a century of progress in the art and practice of electroplating.—A. R. P.

VII.—ELECTROMETALLURGY AND ELECTROCHEMISTRY

(Other than Electrodeposition and Electro-Refining.)

(Continued from p. 85.)

***Behaviour of Tin in Electrolysis with Alternating Current in Alkaline Media.** E. Vallesi (*Boll. Soc. Eustach.*, 1933, 31, 1-2; *Chem. Zentr.*, 1933, 104, II, 2318).—The passage of an alternating current between tin electrodes in sodium hydroxide solution results in part of the metal dissolving as stannite and stannate, and part being converted into a powdery black form which adheres to the electrodes. The amount of tin dissolved rises with increasing current density, temperature, and time, but decreases with increasing concentration of alkali.—A. R. P.

Relation Between the Growth of a Cathodic Deposit and the Form of the Electric Lines of Force. A. Glazunov and O. Rada (*Chim. et Ind.*, 1933, 29, Special number (June), 736-738).—By placing obstacles having various shapes between the electrodes during copper electrolysis the deposit has been obtained in the form of dendrites which in their growth are stated to follow the lines of flow of the current.—W. A. C. N.

KZ, KG_I, and KG_{II} During the Formation of the Cathodic Deposit. A. Glazunov and J. Janousek (*Chim. et Ind.*, 1933, 29, Special Number (June), 739-742).—By following the process of electrolysis with the aid of the microscope, it has been found that the formation of the cathodic deposit is a function, not only of the linear velocity of crystallization normally to the cathode surface, and the number of centres of crystallization, but also of the growth of those centres. There exist two linear velocities of crystallization during deposition—that normal to the cathode (KG_I) and that parallel to the surface of the electrode (KG_{II}). The apparatus with which these microscopical observations have been made are fully described.—W. A. C. N.

A Study of the Tellurium Electrode. Frederick H. Getman (*Trans. Electrochem. Soc.*, 1933, 64, 201-208).—See *J. Inst. Metals*, 1933, 53, 513.—S. G.

VIII.—REFINING

(Including Electro-Refining.)

(Continued from p. 24.)

The Copper Refinery at Prescott. D. W. Aldridge (*Met. Ind. (Lond.)*, 1933, 43, 605–608, 631–633; 1934, 44, 9–12, 87–90).—Read before the Midland Metallurgical Societies (Birmingham Local Section of the Institute of Metals, Birmingham Metallurgical Society, and Staffordshire Iron and Steel Institute). A description is given of the lay-out of plant and charging and furnace equipment. The furnace is coal-dust fired through fan-tail burners. The moulds are carried on cantilever arms disposed radially around and hung from the vertical wall of a 13-ft. hub. After the mould has passed approximately 170° from the pouring point, the casting is automatically turned out into a water bosh, and carried to the transport wagons on conveyors. The mould rights itself, and is returned to the pouring point. The operator's cabin is located within the hub. The copper is transferred from the furnace to a refractory-lined cast-iron ladle through a refractory-lined cast-iron channel section launder. Branches from this main launder divert a portion of the stream from time to time to the mould press. For charging, the furnace is lined with bales of scrap wire to prevent damage by the blister pigs. After 4–6 hrs., the slag is skimmed. In the next or "flapping" stage, the air supply is increased, and the bath is saturated with cuprous oxide, and the minute amounts of impurities are oxidized and slagged or volatilized, buttons being taken to test the "set" of the metal. Before poling, refined copper is added to the charge, which is covered with coke to prevent surface oxidation. Poling is continued until the correct pitch is obtained as shown by buttons. The moulds are dressed with a watch-suspension of finely-ground bone ash applied with a spray gun. Details of casting control, determination of "set," manufacture of moulds, technical control, bath samples and inspection are given, and the characteristics of B.C.R. copper are described.—J. H. W.

***Removal of Zinc with Chlorine in the Refining of Lead.** Jesse O. Betterton (*Amer. Inst. Met. Min. Eng. Tech. Publ. No. 504*, 1933, 1–7).—After desilverizing lead by the Parkes process the lead contains 0.5–0.6% of zinc. This can be efficiently and cheaply removed by pumping the lead continuously through a cylinder up which a current of chlorine is passed, whereby all the zinc is converted into chloride; the small amount of lead converted into chloride at the same time may be removed by melting the slag with metallic zinc. The resulting zinc chloride is readily marketable.—A. R. P.

IX.—ANALYSIS

(Continued from pp. 86–90.)

On the Application of Electron Tubes and Undamped High-Frequency Vibrations in the Quantitative Spectrum Analysis. G. Potapenko (*Z. anorg. Chem.*, 1933, 215, 44–48).—A device for the production of sparks by undamped high-frequency vibrations is described. The spark is remarkably constant, the results are easily reproducible, and the spectra are practically completely free from air lines.—M. H.

†On the Principles of Quantitative X-Ray Analysis of the Concentration of Metal Phases in an Alloy or Mixture. R. Glocker (*Metallwirtschaft*, 1933, 12, 599–602).—The factors which determine the intensity of the lines in X-ray and interference photographs are discussed. No generally valid rules can be laid down, but every individual case must be carefully discussed.—v. G.

Analytical and Quantitative Lines of Silver, Arsenic, Bismuth, Cadmium, Copper, Mercury, Lead, Antimony, and Tin in the Arc Spectrum Between $\lambda = 2330$ A. and $\lambda = 3400$ A. S. Piña de Rubies and M. Amat Bargues

(*Z. anorg. Chem.*, 1933, **215**, 205-210).—The analytical and quantitative lines in the arc spectrum of these metals between 2330 and 3400 Å. are tabulated. Analytical lines are the total number of lines for 1% of an element; this number is always the same if the same quantity of substance is volatilized. Quantitative lines are those analytical lines the intensities of which are not altered by the electrical conditions of the arc within certain limits and which, therefore, are most suitable for quantitative work.—M. H.

Tentative Methods of Chemical Analysis of Ferro-Tungsten and Ferro-Molybdenum (A 104-32 T). — (*Amer. Soc. Test. Mat. Tentative Standards*, 1933, 173-181).—See *J. Inst. Metals*, 1933, **53**, 365.—S. G.

Tentative Revision of Methods of Chemical Analysis of Ferro Alloys (A 104-27). — (*Amer. Soc. Test. Mat. Tentative Standards*, 1933, 1068; and *Proc. Amer. Soc. Test. Mat.*, 1933, **33**, (I), 1030).—The "Tentative Methods of Chemical Analysis of Ferro-Tungsten and Ferro-Molybdenum" (preceding abstract) are in effect a tentative revision of and are intended when adopted to be incorporated in the present standard methods A 104-27.—S. G.

Contribution to the Sampling of [Type Metal] Alloys. Ot. Quadrat and J. Jiristě (*Mezinárodní Sjezd Slevárenský, Praha (Internat. Foundry Congress, Prague)*, 1933, 299-304 [in Czech]; 304-310 [in French]).—In the analysis of Pb-Sb alloys with or without Cu and Sn, accurate samples of an ingot cannot be obtained by drilling, but only by melting the alloy and granulating a dip sample taken out of the homogeneous liquid. Numerous examples are given illustrating this fact.—A. R. P.

***Electro-Analytical Determination of Chromium with the Rotating Mercury Electrode.** Panta S. Tutundzić (*Z. anorg. Chem.*, 1933, **215**, 19-22).—With the rotating mercury electrode 0.1-0.2 grm. of chromium can be deposited from sulphate solutions as amalgam within 2 hrs. compared with the 14 hrs. necessary with a stationary electrode.—M. H.

On the Analytical Chemistry of Pure Aluminium [Determination of Its Sodium Content]. Anon. (*Metallbörse*, 1933, **23**, 179).—A preliminary note on a new method of determining Na in pure Al. The separation is based on the precipitation of Al as a crystalline basic sulphite by boiling a SO_2 solution. —A. R. P.

***Phenanthroline-Ferrous Ion.—II. Oxidation Potentials at High Acidities and the Determination of Vanadium.** George H. Walden, Jr., Louis P. Hammett, and Sylvan M. Edmonds (*J. Amer. Chem. Soc.*, 1934, **56**, 57-60).—V as V_2O_5 in H_2SO_4 is titrated with dilute FeSO_4 solution with one drop of 0.025M ferrous phenanthroline indicator. The colour change is from greenish-blue to reddish-green, and provides a rapid method of analysis.—R. G.

X.—LABORATORY APPARATUS, INSTRUMENTS, &c.

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

(Continued from pp. 90-91.)

***An Apparatus for the Growth of Metal Single Crystals.** Maurice F. Hasler (*Rev. Sci. Instruments*, 1933, [N.S.], **4**, 656-660).—Apparatus and a process for producing very uniform single-crystalline rods of low melting point metals are described. A polycrystalline bar of the metal is cast in a mould of Acheson graphite. The rod is "seeded" at one end with a crystal having the desired crystallographic orientation, and transferred to a trough of poorly conducting material, e.g. diatomaceous earth, and heated at the end with a small hydrogen flame so that the bar and "seed" fuse together. The seeded bar is transferred to a graphite growing mould and introduced into a furnace with the "seeded" end extending outside the furnace. The furnace is then moved down the length of the bar. The method allows single crystals to be grown in any gas

or *in vacuo*, and has been successfully applied to the production of single crystals of bismuth of dimensions $1.25 \times 3 \times 120$ mm. The percentage of successful growths ranges from 70% to 100%, according to the desired crystallographic orientation. The method has also been applied to the production of tin and cadmium crystals.—J. S. G. T.

Polishing Machine for Metallurgical Research. Anon. (*Met. Ind. (Lond.)*, 1934, 44, 96).—A brief description is given of a compact, efficient, and self-contained machine for polishing metallographic specimens.—J. H. W.

***Characteristic Curves of Some Photographic Plates in the Ultra-Violet.** B. K. Johnson and M. Hancock (*J. Sci. Instruments*, 1933, 10, 339-344).—Different photographic plates have been investigated in the ultra-violet part of the cadmium spark spectrum. Their relative speeds, contrast factors, and suitability for particular wave-lengths in ultra-violet microscopy are discussed.—W. H.-R.

New Vacuum Valves and Their Applications. A. W. Hull (*Trans. Amer. Inst. Min. Met. Eng.*, 1932, 102, 17-32).—The following recent developments of the vacuum valve are described and illustrated: 2 types of Plotron, adapted respectively for detecting very small ampérages and measuring small voltages; a cathode-ray tube adapted for X-ray chemical analysis of specimens external to the tube; the cæsium photo-electric cell, sensitive to red light; several types of Thyatron, for the production of gradual or abrupt variations of current, and hence of possible wide application in heating and welding practice; the Phanotron, an arc-discharge, heat-shielded tungsten cathode rectifier. Possible future developments are indicated.—P. M. C. R.

***The Electrolysis of Sodium Through Pyrex Glass.** Eugene W. Pike (*Rev. Sci. Instruments*, 1933, [N.S.], 4, 687).—The production of gas-free sodium by electrolysis of a bath of molten sodium nitrite surrounding a vessel of Pyrex glass is briefly referred to. The metal so produced is exceedingly efficient as a "getter" in vacuum tubes.—J. S. G. T.

Photoelectric Cells of Copper Oxide. R. Jouaust (*Technique moderne*, 1933, 25, (5), 178).—Abstract of an article in *Bull. Soc. Franç. Élect.* (see *J. Inst. Metals*, 1933, 53, 323), on the properties and applications of a cell made by oxidizing one side of a thin copper foil and covering the copper monoxide layer with a thin coating of gold or silver transparent to light. Curves are given of the sensitivity of the cells to light of different wave-lengths. The resistance is stated to be 1500 ohms, the sensitivity 100 m. amp. per lumen (compared with 20μ A. for ordinary cells), and with the cell used (16 mm. diam.) the photo-electric current was almost completely proportional to the light flux received. Examples are given of applications.—R. B. D.

Width and Thickness Measurements of High Precision. [Marcel] Mennesson (*Usine*, 1932, 41, (20), 31, 35).—See *J. Inst. Metals*, 1933, 53, 371.—R. B. D.

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

(Continued from pp. 91-95.)

***The Measurement of Wear by Friction Between Hard Surfaces.** N. Sawine (*Génie civil*, 1933, 103, 254-257).—Wear of surfaces is the result of two processes: (a) a loosening of particles on the surface, and (b) a removal of these loosened particles. The most important factors influencing wear are the hardness of the surfaces and the ductility of the material. These two factors are in turn determined by the metallographic constitution of the metal and also by the homogeneity of the metal. S. briefly describes the various methods which have been used to determine the resistance to wear of metals.

and gives a detailed description of a machine designed for the rapid determination of the wear on hardened surfaces. The machine uses a rotating disc made from tungsten carbide which can be loaded to various pressures. Data are given indicating the effect of various coolants or lubricants on the rate of wear.—W. P. R.

A New Method for Measuring the Mechanical Properties of Metals. L. H. Hounsfield (*Proc. Chem. Eng. Group, Soc. Chem. Ind.*, 1932, 14, 26-39; discussion, 40-42).—See *J. Inst. Metals*, 1932, 50, 754.—S. G.

The Determination and Significance of "Proportional Limit" and "Breaking Strength" in Short-Time High-Temperature Tests. H. F. Moore, J. W. Bolton, and J. J. Kanter (*Proc. Amer. Soc. Test. Mat.*, 1933, 33, (I), 218-224).—Appendix II to Report of Joint Research Committee of A.S.T.M. and A.S.M.E. on Effect of Temperature on the Properties of Metals. See *J. Inst. Metals*, 1933, 53, 519.—S. G.

The Significance of the Results of Short-Time High-Temperature Tension Tests. H. F. Moore, J. W. Bolton, and J. J. Kanter (*Proc. Amer. Soc. Test. Mat.*, 1933, 33, (I), 225).—Appendix III to Report of Joint Research Committee of A.S.T.M. and A.S.M.E. on Effect of Temperature on the Properties of Metals. See *J. Inst. Metals*, 1933, 53, 518.—S. G.

Tentative Method of Test for Long-Time (Creep) High-Temperature Tension Tests of Metallic Materials (E 22-33 T). — (*Amer. Soc. Test. Mat. Tentative Standards*, 1933, 1038-1046; and *Proc. Amer. Soc. Test. Mat.*, 1933, 33, (I), 1004-1012).—See *J. Inst. Metals*, 1933, 53, 518.—S. G.

125 Kilos Hardness Testing Machine. Anon. (*Met. Ind. (Lond.)*, 1934, 44, 86).—Describes a machine suitable for making Brinell hardness tests, using small steel balls as indenters, and for carrying out diamond hardness tests, using a 4-sided pyramidal diamond point. Any desired load from 5 to 125 kg. in 5 kg. increments can be accurately applied to the specimen.
—J. H. W.

†The Notched-Bar Impact Test. Anon. (*Metallurgist (Suppt. to Engineer)*, 1933, 9, 94-95).—A brief discussion of the interpretation of results of notched-bar impact tests.—R. G.

Suitability of the Notched-Bar Impact Test for Testing Welded Joints. P. Bardtke and A. Matting (*Autogene Metallbearbeitung*, 1933, 26, 279-282 and 290-293).—(I.—) The notched-bar impact test and its results are discussed in relation to other mechanical tests. (II.—) The results of tests on welded and unwelded specimens are described. These show the immense importance of standardizing the force and speed of impact, the shape and size of test-piece and notch, and the position of the notch with regard to the weld. It is concluded that the test is valuable as a means of determining the deformability of a weld—a property which may be more important than strength alone, since it allows for redistribution of stresses which may concentrate at any small flaws present.—H. W. G. H.

Unprescribed Tests of Welding. J. C. Holmberg (*Welding*, 1933, 4, 345-347).—The value of impact and fatigue tests is emphasized.—H. W. G. H.

Internal Stresses in Welds. C. T. Schwarze (*J. Amer. Weld. Soc.*, 1933, 12, (11), 23-25).—A bend-testing apparatus is described, having rocker bearings which move with the specimen so as to eliminate secondary stresses as far as possible. This is used to obtain stress-strain curves by means of extensometers placed on base and weld metal.—H. W. G. H.

The Strength of Fillet Welds Under Oblique Loads. R. R. Blackwood (*Modern Eng.*, 1933, 7, 327-330).—Tests were made on arc-welded steel specimens. The unit strength of fillet welds under inclined loads was found to be intermediate between the strength of fillet welds of the same size when loaded as end welds and as side welds. The change in strength was proportional to the angle of application of the loads.—H. W. G. H.

A Milling Test for Welds. — Schmuckler (*Welding Ind.*, 1933, 1, 285-287).—Describes the use of the test in training welders. Typical faults are illustrated.—H. W. G. H.

Innovations in the Magnetic and Electrical Testing of Welded Seams. E. Franke (*Elektrotech. Zeit.*, 1933, 54, 659-660).—New magnetic and electrical methods of testing welds are described which will detect even relatively small faults. The magnetic method makes use of two auxiliary magnets on both sides of the measuring magnet, so that the lines of forces from the latter cannot be easily deflected at a fault, and the change in magnetic force is thereby amplified. The electrical method depends on the measurement of the potential fall in the weld, which is determined by means of a differential galvanometer; the improved set-up of the apparatus increases the sensitivity.—B. Bl.

RADIOLOGY

The Use of X-Rays in the Examination of Metal Objects. Anon. (*Génie civil*, 1933, 103, 527-528).—Describes the use of X-rays for testing the soundness, &c., of metals, for determining the crystal structure and also the elastic deformation of the metal if internal stresses are present.—W. P. R.

†**Weld Testing by X-Rays.** M. Widemann (*Maschinenbau*, 1934, 13, 21-23).—A review.—v. G.

Discussion of the Article "Apparatus for Investigating Materials by X-Rays." — Widemann. Otto Fischer (*Autogene Metallbearbeitung*, 1933, 26, 335-337).—W. criticizes Fischer's nomogram for determining exposure times for varying thicknesses of steel (see *J. Inst. Metals*, 1933, 53, 375), and maintains that the times given by it are too short. F. replies to the effect that the apparatus used by him was more efficient, and the photographic film more sensitive, than those used by W. W. continues to disagree.—H. W. G. H.

New Method of Control for Cast or Welded Parts. — Holweck (*Usine*, 1932, 41, (22), 31).—Brief description of the use of X-rays for the examination of metal parts, and a comparison of the advantages and disadvantages compared with the use of γ -rays of radioactive substances. Powers of X-rays required and weights of radioactive materials are discussed, and the penetrative powers are contrasted. Comparative costs are indicated.—R. B. D.

XII.—TEMPERATURE MEASUREMENT AND CONTROL

(Continued from pp. 95-96.)

Mechanical Design of Thermostatic Bimetallic Elements. H. D. Matthews (*Machinist (Eur. Edn.)*, 1934, 77, 749-751E).—The deflection, D , of the free

end of a bimetallic strip fixed at one end is given by: $D = \frac{k(T_1 - T)l^2}{t}$,

where $(T_1 - T)$ is the temperature change, l the active length of the strip, t the thickness, and k a constant depending on the metals. For a spiral or helix, the rotation, A , in degrees may be expressed by $A = \frac{k(T_1 - T)\lambda}{t}$.

These formulæ are theoretically true only for a special range of temperatures, but with most metals this is fairly wide, say from -50° to $+600^\circ$ C. For higher temperatures, D and A are smaller. The forms and the applications of these strips to thermostatic work are described, and the ratio of thermal expansion of the component elements at 100° F. (38° C.) of a number of binary elements, of which one is from 36-42% nickel-iron, are given.—J. H. W.

Automatic Temperature Control for Industrial Gas Process Ensuring Efficiency and Economy. Anon. (*Gas World (Indust. Gas Suppl.)*, 1934, 6,

(1), 14-15).—The application of a type of temperature regulator for controlling gas- or oil-fired furnaces at temperatures up to about 1000° C. with an accuracy (claimed) to within $\pm 1^\circ$ C. is briefly described.—J. S. G. T.

Servicing a Noble Metal Couple. R. S. Bradley (*Heat-Treating and Forging*, 1933, 19, 80-81, 108-109).—Cf. *J. Inst. Metals*, 1933, 53, 569-570.—J. H. W.

XIII.—FOUNDRY PRACTICE AND APPLIANCES

(Continued from pp. 96-98.)

†**The Melting of Metals.** Anon. (*Metallurgist* (Suppt. to *Engineer*), 1933, 9, 70-71).—A discussion of the possibility of the existence of nuclei in metals above the melting point, referring principally to a paper by W. L. Webster, *Proc. Roy. Soc.*, 1933, [A], 140, 653. See *J. Inst. Metals*, 1933, 53, 486.—R. G.

Progress in Crucible Melting. G. S. Watson (*Met. Ind. (Lond.)*, 1934, 44, 66-67).—The developments that have been made recently in increasing the life of the pot, reducing the fuel consumption, and increasing the size of the melting unit in crucible melting are described.—J. H. W.

Non-Ferrous Castings Made Under Pressure in Plaster Composition Moulds. Anon. (*Iron Age*, 1933, 132, (26), 32).—The metal—bronze, brass, or aluminium—is forced into the mould in a semi-molten condition under slight air pressure, according to the type of casting, the casting temperature being considerably lower than that for sand-castings. The resulting castings are claimed to be superior to sand-castings, the process being intermediate between sand- and die-casting. The primary purpose of the process is to obtain accuracy for ornamental work.—J. H. W.

Casting an Aluminium Screen 2600 mm. Diameter. Anon. (*Z. ges. Giesserei-Praxis: Das Metall*, 1934, 55, 15).—Details of moulding and casting a semi-annular screen 2.6 m. in diameter are given.—J. H. W.

Copper Alloys in Electrotechnology. Anon. (*Metallbörse*, 1933, 23, 445-446).—Discusses the deoxidation, casting, and working of copper alloys for electrical apparatus.—A. R. P.

The Industrial Production of "Aluminium-Bronze." C. H. Meigh (*Bull. Assoc. Tech. Fonderie*, 1933, 7, 111-112).—A reply to Durville's criticism of M.'s paper on this subject.—W. A. C. N.

Moulding and Casting a Pump Casing in Bronze. Anon. (*Z. ges. Giesserei-Praxis: Das Metall*, 1934, 55, 35-36).—Details are given of moulding and casting a pump casing 700 mm. high by 320 mm. external diameter in an alloy consisting of copper 79.2, tin 10.2, lead 9.5, and phosphorus 1.1%.

—J. H. W.

Continuous Production of Brake Shoes and Red Brass in the Works of the Czechoslovakian State Railways. Josef Egermaier (*Mezinárodní Sjezd Slevárenský, Praha (Internat. Foundry Congress, Prague)*, 1933, 399-406 [in Czech]; 407-412 [in French]).—Mechanical casting tables and apparatus for the continuous production of sand castings of cast iron and red brass for railway work are described and illustrated.—A. R. P.

***Castability and Contraction of Magnesium and Its Alloys with Aluminium and Copper.** A. Portevin and P. Bastien (*Mezinárodní Sjezd Slevárenský, Praha (Internat. Foundry Congress, Prague)*, 1933, 17-27 [in French]; 27-33 [in Czech]).—The castability of aluminium-copper, aluminium-magnesium, and copper-magnesium alloys follows the laws previously enunciated (see *J. Inst. Metals*, 1934, 54 (Advance copy)), maxima occurring at eutectic compositions and chemical compounds and minima at the boundary of solid solutions. The castability of pure magnesium in sand moulds containing various additions has been determined; maximum castability is obtained in baked moulds containing 3% of sulphur, and low castability in green moulds containing

boric acid or ferrosilicon. Shrinkage tests showed that sand castings shrink more than chill castings, and that in the magnesium-aluminium system minimum shrinkage occurs with saturated solid solutions, that of magnesium in aluminium being less than that of aluminium in magnesium; for compositions between the two eutectics at 26.5 and 68% aluminium the shrinkage is approximately constant. In the copper-magnesium system the shrinkage decreases rapidly up to 8% copper, then very slowly and linearly up to 32% copper (eutectic), and finally reaches a well-marked minimum at Mg_2Cu . Shrinkage values for copper-magnesium-aluminium alloys with up to 15% of copper and magnesium are shown graphically.—A. R. P.

The Manufacture and Applications of Centrifugal Castings. T. R. Twigger (*Found. Trade J.*, 1933, 49, 321-323).—Read before the Preston Branch of the Institute of British Foundrymen. The present applications of the centrifugal casting process are outlined, especially as regards tyres for railway wheels, using a vertical axis, and lead tubes, using a horizontal mould. The speed of rotation varies with the diameter, being about 1400 r.p.m. for a 2-in., and 400 r.p.m. for a 30-in. diameter casting. The life of the mould also varies considerably and may reach 4000 castings on the smaller sizes. The advantages, applications, and service results of centrifugal castings are described.—J. H. W.

High-Strength Alloys for Die-Casting and Chill-Casting. Anon. (*Werkstatt u. Betrieb*, 1934, 67, (3/4), 58).—The presence of aluminium in certain zinc-base die-casting alloys renders soldering difficult; the substitution of tin or antimony for aluminium facilitates soldering, and suitable compositions are indicated in each case. Even better results are obtained with silver, the recommended composition being: zinc 90, copper 7.5, silver 2.5%.—P. R.

Die-Casting or Stamping? Herbert Chase (*Iron Age*, 1933, 132, (26), 26-28).—Whilst stamping has its advantages in certain cases, there are many conditions under which die-casting is superior, and the application of this process in such circumstances is discussed.—J. H. W.

Developments in Modern Foundry Materials and Equipment. J. W. Gardom (*Iron and Steel Ind.*, 1934, 7, 107-111, 153 and 154).—A review of recent developments in foundry equipment deals with melting units and discusses various types of furnaces, and different methods of firing and heating by means of oil, gas, coke, pulverized fuel, and electricity. Consideration is also given to core-making and to recent improvements in core-drying by means of continuous core stoves, to core-making machines, to sand-mixers, and to moulding machines of various types, including the electric squeeze machine and the electric jolt-moulding machine. Recent work on moulding sands and sand-testing apparatus are also dealt with in detail, and consideration is given to the use of synthetic sands.—J. W. D.

***On the Testing and Classification of Foundry Graphite.** Josef Cibulka (*Mezinárodní Sjezd Slevárenský, Praha (Internat. Foundry Congress, Prague)*, 1933, 215-219 [in Czech]; 219-224 [in French]).—For foundry work, e.g. for making crucibles, moulds, and cores, graphite should have a high carbon content and should be difficultly combustible, especially the fine grains. The ash content should be low and the ash should have a low content of lime and sulphur, which increases the fusibility. Methods of testing graphite are briefly described.—A. R. P.

***The Influence of the Nature of Moulding Sand on the Strength of Metals and Alloys.** H. Lepp (*Mezinárodní Sjezd Slevárenský, Praha (Internat. Foundry Congress, Prague)*, 1933, 95-107 [in German]; 107-112 [in Czech]; 112-118 [in French]).—It is shown that the reduction of tensile strength and gas absorption of sand-castings is due to the reaction $H_2O + Me = MeO + H_2$, which takes place under certain conditions of temperature and pressure in green-sand moulds. Hence it follows that care must be exercised to produce

moulds of the correct moisture content; this content varies with the metal or alloy to be cast, hence for any particular sand tests should be made to determine the ratio between moisture content and permeability. The ratio between permeability and the pressure used in stamping should also be determined; from these two ratios a permeability diagram can be constructed for the sand.—A. R. P.

***The Influence of Baking on the Properties of Moulding Sands.** Bohuslav Holman (*Mezinárodní Sjezd Slevárenský, Praha (Internat. Foundry Congress, Prague), 1933, 539-547 [in Czech]; 548-553 [in French]*).—The grain-size, cohesion in the green state and after drying, resistance to stamping, permeability, and porosity of moulds made from Silesian sand, which has previously been burned at 200°-850° C., have been determined to ascertain the relation between cohesion and clay content. This relation is found to be linear, hence a simple determination of true clay content suffices for the calculation of the amount of clay to be added in using old sand for the making of moulds.—A. R. P.

***Preliminary Experiments on the Simultaneous Action of Various Colloids on the Cohesion of Dried Moulding Sands.** A. Glazunov (*Mezinárodní Sjezd Slevárenský, Praha (Internat. Foundry Congress, Prague), 1933, 563-575*).—[In Czech.] Tests have been made on the binding power of colloids on pure quartz sand. Colloidal silica has no binding power alone, whereas colloidal ferric oxide produces a degree of cohesion of the sand grains which increases with the amount of added ferric oxide up to 4%. Colloidal silica inhibits the binding power of ferric oxide.—A. R. P.

Sands for Non-Ferrous Foundries. Alfred B. Searle (*Met. Ind. (Lond.), 1934, 44, 69, 73*).—A short discussion of the requirements of such sands is given.—J. H. W.

The Practical Benefits of Green-Sand Testing. N. D. Ridsdale (*Found. Trade J., 1933, 49, 292*).—Abstract of a "Report on Routine Methods for Testing Green-Sands," presented to the Middlesbrough Branch of the Institute of British Foundrymen. The Report recommends that the following methods should be standardized for use in Great Britain: *For moisture*—the "Speedy" (patent) moisture tester. *For Ramming and Test-Piece*—the A.F.A. standardized drop-ram and 2-in. diameter by 2-in. long test-piece. *For Permeability*—the A.F.A. apparatus or Richardson's modification. *For Bond Strength*—the A.F.A. test-piece using B.C.I.R.A. compression apparatus. Typical sand problems are set out and answered, and possible sand-test values (by Dietert) are tabulated.—J. H. W.

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

(Continued from pp. 98-99.)

The Remelting of Difficult Foundry Scrap in the Aluminium Foundry. R. Thews (*Metallbörse, 1933, 23, 277-278*).—Practical hints.—A. R. P.

The Position of Iron in the Metallurgy of the White Metals. Edmund R. Thews (*Met. Ind. (Lond.), 1933, 43, 367-368, 376*).—Some of the most important rules governing the action of iron and its compounds in white metals and some practical examples and applications are given relating to the treatment of white metal ashes.—J. H. W.

The Position of Iron in the Metallurgy of White Metals. W. E. Hoare (*Met. Ind. (Lond.), 1933, 43, 402*).—A letter pointing out that there is no iron-tin compound containing theoretically 13% tin as claimed by E. R. Thews in his paper of the above title (see preceding abstract).—J. H. W.

Iron-Tin Compounds. Edmund R. Thews (*Met. Ind. (Lond.), 1933, 43, 449-450*).—T. confirms the statement in W. E. Hoare's letter (preceding abstract) that there is no iron-tin compound containing 13% tin.—J. H. W.

XV.—FURNACES AND FUELS

(Continued from pp. 99-101.)

Finish of Tubing Improved by Using Inexpensive Bright-Annealing Furnace. Anon. (*Iron Age*, 1933, 132, (25), 17).—A specially designed continuous electric furnace using a special gas atmosphere is used in annealing copper tubing in both coils and straight lengths, thus eliminating the usual pickling, washing, and drying operations, and giving a superior finish to the product.—J. H. W.

Electric Furnace with Controlled Atmosphere. R. F. Benzinger (*Heat-Treating and Forging*, 1933, 19, 105-107).—The advantages and applications of electric furnaces with controlled atmospheres for most metallurgical operations, and the properties of the more commonly used gases are described.—J. H. W.

Economics of Electric Resistor Furnace Design and Construction in Japan. James A. Rabbitt (*Japan Nickel Rev.*, 1933, 1, 240-291).—[In English and Japanese.] Following a general introduction dealing with the advantages of electric heating and the specialized knowledge necessary to design successful electric furnaces, is an instructive discussion of methods of construction. Losses are carefully reviewed, and the question of heat insulation is dealt with fairly completely with the aid of tables and calculations. The various types of resistors, and their composition, design, and arrangement are described and compared, having regard to the conditions of operation.—W. A. C. N.

Rim-Type Heating Resistors. A New System of Metallic Heating Elements in Electric Industrial Furnaces. O. Junker (*Met. Ind. (Lond.)*, 1933, 43, 487-489).—This new type of heating element consists of strips of heat-resisting alloy shaped in a similar way to a bicycle rim, placed side by side to form the roof and sides of the muffle chamber. Alternate ends are welded together so that the strips are connected in series. The refractory and insulating material is supported by the resistors, except in the case of furnaces over 800° C., where the refractory is made self-supporting. The whole of one side of the strip is free to radiate heat, and it is claimed that it can be operated at high wattage densities, and as the refractory parts are light, quick heating up of the furnace from cold can be achieved. It is claimed that this construction is simple and inexpensive.—J. H. W.

FUELS

A Competitive Test Rejects the Vapofier. Frank H. Trembly, Jr. (*Gas Age-Record*, 1933, 72, 551-553).—The Vapofier is a device for vaporizing light grade oil and mixing the vapour with air in roughly the correct proportion for combustion. Details of tests of the Vapofier in competition with town's gas for carburizing are given.—J. S. G. T.

Development in the Applications of Solid Fuel to Non-Ferrous Furnaces. John Fallon (*Met. Ind. (Lond.)*, 1934, 44, 63-65).—The developments in controlling the atmosphere and the use of the automatic gas machine are described, and some comparative costs of solid fuels, oil, gas, and electricity are given.—J. H. W.

***Study of the Reactivity and Porosity of Foundry Coke.** Samuel Václav (*Mezinárodní Sjezd Slevářenský, Praha (Internat. Foundry Congress, Prague)*, 1933, 431-437 [in Czech]; 437-441 [in French]).—Porosity determinations allow conclusions to be reached as to the chemical properties of the coke but give no indication of the pore size, or whether the coke was made at high or low temperature. Data on the density and inner structure of coke can, however, be obtained by determining the permeability to gases in the same type of apparatus as that used for testing moulding sand. Reactivity tests with powdered coke taken from the surface and from the interior of large

Graphite in Refractories. Erich Buchholz (*Tonind. Zeit.*, 1933, **57**, 1207-1208).—The nature of the stresses to which refractory crucibles are subjected in use, the function of the graphite additions, and the different forms and structure of graphite are described.—B. Bl.

Thorium Oxide, a High-Temperature Refractory. Oscar O. Fritsche, H. B. Wahlin, and Joseph F. Oesterle (*Trans. Electrochem. Soc.*, 1933, **64**, 329-339).—See *J. Inst. Metals*, 1933, **53**, 580.—S. G.

***On the Relation Between the Permeability to Water and Structure of Refractories.** Otto Bartsch (*Tonind. Zeit.*, 1933, **57**, 1158-1159, 1182-1183).—In determining the porosity of refractories the permeability to water, especially in relation to the firing temperature, the temperature at which the grog has previously been burned, the size of the grog, and the method of making the bricks, is of more importance than the permeability to gases.—B. Bl.

Magnesite Bonding Mortar. Anon. (*Blast Fur. and Steel Plant*, 1934, **22**, (1), 49).—Announces a new mortar consisting of bonds, one to give a cold set, others to give strength at higher intervals of temperature. It has been developed for a special application in the copper industry.—R. Gr.

Better Clay Products Through Evacuation. C. H. Vivian (*Compressed Air Mag.*, 1933, **38**, 4095-4098).—A description of the de-aeration process, and its effects on clays intended for furnace lining, fireboxes, and other applications. Durability is considerably increased, with some decrease in the insulating power of the material.—P. M. C. R.

Refractories. Anon. (*Refractories Bull. (John G. Stein & Co., Ltd.)*, 1933, (19-24)).—In this series of 2-page monthly Bulletins further features and properties of refractories are dealt with, which include the shaping of refractories, the chemical and physical properties of mullite, vitrification, the slagging of a firebrick, the chemical and physical properties of corundum, and progress in refractory practice. In the last Bulletin, which concludes the present series, the necessity of keeping accurate observations of working conditions accompanied by critical examination of furnaces when off, together with the laboratory testing of bricks under defined conditions, is emphasized.—J. W. D.

Tentative Definitions of Terms Relating to Heat Transmission of Refractories (C 71-31 T). — (*Amer. Soc. Test. Mat. Tentative Standards*, 1933, 373-374).—See *J. Inst. Metals*, 1933, **53**, 47.—S. G.

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XVII.—HEAT-TREATMENT

(Continued from p. 102.)

"Fireless" Salt Baths. A. E. Bellis (*Metal Progress*, 1934, **25**, (1), 25-28).—The high operating temperature of salt baths for the heat-treatment of metal parts necessitates the use of pots made of high-chromium alloys; nickel-chromium alloys proved unsuitable owing to electrolytic action. Modifications of design for specific purposes are described, including equipment for annealing bar silver, silver tableware, steel wire, tubing, and stainless steel, and for the treatment and reconditioning of tools.—P. M. C. R.

XVIII.—WORKING

(Continued from pp. 102–103.)

***Ears on Cupro-Nickel Cups.** W. H. Bassett and J. C. Bradley (*Amer. Inst. Min. Met. Eng. Preprint*, 1932).—The edges of drawn cupro-nickel cups often have 4 ears. These may be produced either at 45° to the direction of rolling or at 90° (and 0°) to the direction of rolling. By systematically reducing the gauge of cupro-nickel at which the intermediate anneal is introduced, a series of cups has been made in which the ears varied in regular fashion as follows: short 90° ears, long 90° ears, shorter 90° ears, no ears, short 45° ears, long 45° ears, short 45° ears, no ears. Variations in composition of the cupro-nickel affect earing tendencies. The length of the 90° ears increases with the final annealing temperature. Earing is evidently due to directionalism in the arrangement of the crystalline structure and to methods of rolling and annealing which bring about directional arrangement.—S. G.

Interesting Observations on the Formation of Cracks in Argentan Rings During Drawing. Anon. (*Werkstatt u. Betrieb*, 1934, 67, (3/4), 67).—The original drawing process is described; the high proportion of rejections (25%) is traced to the poor finish at the edges of a circular hole, stamped prior to the final drawing. Subsequent improvements in the process are indicated.

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Early Developments of the Rolling-Mill. Anon. (*Wire and Wire-Drawing*, 1933, 8, 263–264, 282).—A short history of rolling-mill developments as compiled by the Research Department of the United Engineering and Foundry Co. It is thought that the rolling mill may be a development of the early wire-drawing bench of the 14th century, because of the advantages presented by grooved rolls over dies.—J. H. W.

Forging and Stamping Light and Ultra-Light Alloys. **Observations on the Flow of the Metal.** E. Decherf (*Aciers spéciaux*, 1933, 8, 315–327).—Cf. *J. Inst. Metals*, 1933, 53, 214. The description of the forging and stamping of light alloys is continued. The following cases are considered: rough shaping by complete hammering of the initial billet, stamping permitting the use of only one pair of dies; the same, but stamping consisting of a cambering process; similar rough shaping, stamping consisting of two operations, one of which is in rough-shaping dies. The heat-treatment and the effect of “burning” the metal are discussed, and the machines used in working these alloys are briefly described.—J. H. W.

Pressed Brass. Anon. (*Werkstatt u. Betrieb*, 1934, 67, (3/4), 61–62).—A 58:42 brass is recommended for hot-pressing; some details of the process are described, with emphasis on the importance of temperature control. The material is said to be non-porous, to have a higher softening point (300°–400° C.) than that of copper, to resist the action of steam and of certain acid solutions, and to possess a high thermal conductivity which renders it especially suitable for the making of bearing casings.—P. M. C. R.

Process Working Pressures. XXI.—**Coining.** Anon. (*Machinist (Eur. Edn.)*, 1933, 77, 762–763).—The operations and pressures required in coining steel and various non-ferrous blanks are given.—J. H. W.

Band-Saws and Aluminium Foundries. Anon. (*Met. Ind. (Lond.)*, 1934, 44, 137–138).—Although wood-working band-saws can be made to give satisfactory service for a considerable time, it is much better to instal a proper metal-cutting band-saw, fitted with self- or air-hardening steel saws. The saw can be run at 3000–4000 ft./minute for average work, but for silicon and other special alloys, 1000 ft./minute is fast enough. Details of running the machines and sharpening the saws are given.—J. H. W.

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†From the Literature on the Sawing of Metals. E. Kurz (*Maschinenbau*, 1934, 13, 39-40).—A review, with extensive bibliography.—v. G.

Experiences in Machining Aluminium Alloys.—I. —II. Roland V. Hutchinson (*Machinist (Eur. Edn.)*, 1933, 77, 645-647, 686-688).—Details and examples are given of turning, shaping, milling, boring, and counter-boring aluminium alloys used in aeroplane construction.—J. H. W.

Drilling with Hard Metal. Kurt Seidel (*Werkstatt u. Betrieb*, 1934, 67, 50-52).—Tables show the relative diameters and revolutions per minute for the drilling of materials of varying degrees of hardness by means of Widia tools, and appropriate grades of Widia, cutting speeds, permissible drive for 2 diam. of tool, cutting angle and cooling medium for 16 alloys and for certain non-metallic materials. Suitable forms of drill are indicated.—P. M. C. R.

Materials for Modern Cutting Tools. J. V. Emmons (*Metal Progress*, 1933, 24, (6), 35-40).—A discussion of common tool materials and their appropriate applications.—P. M. C. R.

XIX.—CLEANING AND FINISHING

(Continued from p. 103.)

Pickling Solutions for Zinc, Tin, Lead, and Their Alloys. — - Krause (*Z. V. d. Kupferschmied*, 1933, 45, 182-183).—Practical hints are given.—M. H.

A New Process for Descaling Metals. Floyd D. Taylor (*Canad. Mach.*, 1933, 44, (6), 19-20, 29).—Abstract of a paper read before the American Gear Manufacturers' Association. A discussion of the nature and properties of scale is followed by a classification of descaling methods. T. advocates an electrolytic process which combines scale removal and immediate deposition on the cleaned surface of a protective metallic coating, usually of lead or tin. Preparation, bath, and equipment are described.—P. M. C. R.

Modern Methods of Etching and Colouring [Metals]. G. H. Mamerow (*Monthly Rev. Amer. Electroplaters' Soc.*, 1933, 20, (1), 15-18; discussion, 18-22).—Practical hints on etching and plating designs and lettering on metal plates and articles.—A. R. P.

XX.—JOINING

(Continued from pp. 104-105.)

*Soldering and Brazing [of Aluminium]. A. G. C. Gwyer (*J. Sci. Instruments*, 1933, 10, 396-397).—A note. The statement by Newman and Clay (*ibid.*, 333), that no satisfactory solder exists for aluminium is criticized. Suitable solders are formed by alloys of aluminium with either 5% or 10-13% of silicon, the latter composition being the easier to work. A commercial fluoride flux is used, and applied on the end of the solder stick. The parts to be joined are clamped together, the solder stick is heated and dipped in flux and then, using a gas blowpipe with a small flame, the solder stick is melted and run along the joint.—W. H.-R.

Welding Non-Ferrous Metals. Anon. (*Metallurgist (Suppt. to Engineer)*, 1933, 9, 83-84).—A brief review, emphasizing the need for investigation of the welding of non-ferrous metals.—R. G.

Welding Methods for Non-Ferrous Metals [Aluminium]. Anon. (*Metallbörse*, 1933, 23, 146-147, 178).—Notes on modern practice in welding aluminium.—A. R. P.

Fabrication by Fusion Welding of Pipes and Barrels in Copper. Anon. (*Soudeur-Coupeur*, 1933, 12, (11), 6-10).—Illustrations and descriptions of heavy cylindrical work by a Japanese firm.—H. W. G. H.

Food Processing Vats Made of Welded Copper. Anon. (*Welding Eng.*, 1933, 18, (12), 25-26).—Three vessels for processing cereal food products are illustrated and described. They are fabricated from tough-pitch copper by "long arc" welding. Details of the construction and technique are given.

—H. W. G. H.

How to Weld Copper by the Blowpipe. Anon. (*Soudeur-Coupeur*, 1933, 12, (11), 5).—Brief instructions in technique.—H. W. G. H.

Welding of Commercial Yellow Brass Pipe and Other Non-Ferrous Piping. D. E. Roberts (*J. Amer. Weld. Soc.*, 1933, 12, (11), 7-10).—For copper and brass pipe, bronze-welding is recommended even when corrosion is to be expected, since it is considered that greater soundness of the joint will be obtained than from a rod of composition approximating to the base metal. The butt-type joint with ends bevelled at 45° is preferred to the bell-and-spigot because of greater efficiency and lower cost. Test and cost data are given for joints in 4-in. brass pipe.—H. W. G. H.

The Welding of Inconel. F. G. Flocke, J. G. Schoener, and R. J. McKay (*J. Amer. Weld. Soc.*, 1933, 12, (11), 16-20; and *Welding Eng.*, 1933, 18, 11, 22-26).—Inconel (nickel 80, chromium 14, iron 6%) may be welded by all the usual methods. Heavy-coated electrodes for the arc process, and a suitable flux for oxy-acetylene welding, are essential. Ductile welds of 100% strength can be obtained. The corrosion-resistance of welds is equal to that of the parent metal, which is also only slightly affected by the strain and recrystallization due to welding. No carbide precipitation can be detected.

—H. W. G. H.

The Welding of Monel Metal and Nickel. Anon. (*Met. Ind. (Lond.)*, 1934, 44, 115-118, 139-140).—An account is given of the welding of Monel metal and metal, adapted from two trade publications.—J. H. W.

Finds Means of Welding Rare Metal (Tantalum). Anon. (*Welding Engineer*, 1933, 18, (12), 18).—Since welds performed in air were found to be hard and brittle, a device made of 24-gauge tantalum sheet was made, partly by seam resistance welding under water, and partly by carbon arc welding while immersed in a chemical solution.—H. W. G. H.

The Metal-Arc Welding of Galvanized Steel. Leon C. Bibber (*J. Amer. Weld. Soc.*, 1933, 12, (12), 4-9).—Experiments conducted by the U.S. Navy Department, Bureau of Construction and Repairs, show that, in plating $\frac{1}{2}$ in. thick and over, normal welding on one side will not burn off the galvanizing on the other side. The corrosion-resistance of plating from which the zinc has been apparently burned off by the heat of welding, is not greatly reduced. The zinc is completely burned off only in a narrow zone alongside the weld; it is melted at a considerable distance from the weld, but the protection in this zone is not impaired. Small single bead fillets seem to be practically as resistant to corrosion by salt-spray as the original plate, but large multiple bead welds are readily attacked.—H. W. G. H.

Building Up Pistons and Maintenance of Reciprocating Parts by Bronze-Welding. T. W. Greene (*J. Amer. Weld. Soc.*, 1933, 12, (11) 4-7).—Pistons and valves of engines, compressors and pumps are re-surfaced by the oxy-acetylene process, using a manganese-bronze filler rod giving a Brinell hardness of 93-98. This is suitable for surfaces which are not exposed to temperatures higher than 500° F. (260° C.). Because of the risk of intergranular penetration, it is unsuitable for steel parts which are subject to alternating stresses.—H. H.

Rebuilding Worn Parts by the Oxy-Acetylene Process. Anon. (*Oxy-Acetylene Tips*, 1933, 12, 252-253).—Essential information for using a comprehensive range of hard-surfacing alloys is given in tabular form.—H. W. G. H.

The Present State of Welding of Non-Ferrous Metals. J. C. Fritz (*Anz. Berg-, Hütten- u. Masch.*, 1933, 55, (59), 4-5).—The applicability of the various welding methods to non-ferrous metals, especially aluminium and its alloys,

copper, zinc, lead, nickel, and Elektron is described, as well as the brazing of hard alloys.—B. Bl.

Resistance Welding Non-Ferrous Metals and Alloys. H. A. Woofter (*Welding*, 1933, 4, 259-262, 301-303, 354-357, 403-406).—The development of copper welding by resistance methods is described and the modern machines and technique are discussed. Flash-welding is not as successful as butt-welding, for which great welding speed is essential for good results. Seam- and spot-welding are successful on thin-gauge material, but the application to thick material is difficult on account of the high conductivity of copper. Nothing is known concerning the projection welding of copper. Aluminium resistance welds must also be made very rapidly. They must, moreover, be annealed to prevent deterioration by corrosion. Brass presents little difficulty, but bronze gives trouble on account of volatilization of some of its constituents. Rapidity of welding is necessary, too, for nickel and Monel metal.—H. W. G. H.

Development and Application of Automatic Welding Controls. H. W. Roth (*J. Amer. Weld. Soc.*, 1933, 12, (12), 10-13).—After a historical survey of control systems for resistance welding, the Controloweld mechanical synchronous control is described. This measures the current, supplied to the welding transformer, in cycles, the "make" being adjustable to any desired point of the sine wave, and the "break" taking place in zero.—H. H.

Timing of Spot Welders with Respect to Current Flow. D. C. Wright (*J. Amer. Weld. Soc.*, 1933, 12, (12), 13-16).—An automatic weld timer is described by which the product of the welding current and the time of current flow are kept constant. This enables good welds to be obtained, without changing adjustments, on material of varying thickness or resistance.—H. H.

Precision Spot Welding with Tube Controlled Contactors. Carroll Stansbury (*J. Amer. Weld. Soc.*, 1933, 12, (12), 17-22).—The design of some synchronous timers and contactors for use with them, is discussed. A method, cheaper than the oscillograph, for checking the timing, is described.

—H. W. G. H.

Electric Twin Spot-Welding. René Leonhardt (*Welding Ind.*, 1933, 1, 309-310).—Describes a spot-welding machine in which the contact points are arranged side by side and not one above the other.—H. W. G. H.

The Present State of Electric Welding. Karl Meller (*Elektrotech. Z.*, 1933, 54, 656-659).—Modern electric welding methods and apparatus are described and their sphere of usefulness is discussed.—B. Bl.

New Methods of Construction of Large Butt-Welding Machines. H. Wilbert (*Elektroschweissung*, 1933, 4, 141-143).—The machines described are themselves fabricated by welding. They are designed so as to permit of easy conversion from manual control of the butting and welding to semi-automatic (in which the welding pressure is applied mechanically) or fully automatic working (in which all the operations are mechanically controlled). The method of clamping the parts to be welded may also be changed with ease from hand-operated to power-operated mechanism.—H. W. G. H.

Arc Welded Fusion Metal. Robert Notvest (*Welding*, 1933, 4, 535-539).—A discussion of the mechanism of the d.c. arc, mainly from the point of view of steel welding.—H. W. G. H.

Speed of Fusion of Electrodes. V. P. Wologdin (*Elektroschweissung*, 1933, 4, 188-191).—An account of tests made to determine the speed of fusion of steel electrodes and the causes of loss by vaporization and sparking. The factors considered are: the type of current, the amperage, the kind of electrode, the electrode coating, the polarity, and the position of the seam.

—H. W. G. H.

XXI.—INDUSTRIAL USES AND APPLICATIONS

(Continued from p. 106.)

The Use of Telephone Conductors of Cabled Aluminium Wire in Indo-China. — Reufflet (*Ann. Postes, Télég. Téléph.*, 1933, 22, 1002-1006).—The iron wire formerly used as conducting material for telephones in Indo-China was replaced in 1927 by 3-strand cables of aluminium wire, with satisfactory results. A great economy in upkeep has been effected, and certain disadvantages experienced in the use of aluminium conductors in France have been eliminated, notably that of electrolytic attack at points of support.—P. M. C. R.

Safety and Design in Aero Construction. Alfred Techmann and Franz Michael (*Automobiltech. Z.*, 1934, 37, (2), 28-36).—A summary of current conceptions of safe load, residual stresses, breaking stresses, fatigue, stability, buckling stress, and mechanical strength is accompanied by a review of recommended factors of safety in most of the foregoing cases. A graph shows such factors for rods under bending and buckling stress, and for similarly stressed flanges. Efficiency factors, calculated from the relevant formulæ, are given for 3 woods, 4 steels, hard and soft Duralumin, Hydronalium and Elektron, cast Elektron and Silumin. The influence of material on the optimum form of spars is shown diagrammatically, together with weights per unit length and bending strengths. The danger of setting up buckling stresses at joints and seams is illustrated by views of actual fractures. A consideration of the effect of working stresses on the strength of members includes diagrams showing dangerous and improved methods of altering cross-section of jointing in thin sheet and of reinforcing flat surfaces. The average endurance of aero parts is discussed, and curves are given for the calculation of their probable life. The phenomena of rigidity should be investigated more fully with the aid of models.—P. M. C. R.

Copper Pipes in Sanitary Plumbing. M. Muzard (*Cuivre et Laiton*, 1933, 6, 567-570).—Reproduced from *Le Plombier Français*. Investigations are described in which lead, galvanized iron, and copper pipes were compared side by side in certain sanitary installations. It is shown that copper has marked superiority over its competitors, especially on account of its resistance to the inherent corroding influences. The economic advantages of copper are also studied.—W. A. C. N.

Fourdrinier Wire Cloth. — (*U.S. Bur. Standards, Commercial Standard CS 36*, 1933).—This wire cloth, used in paper-making machines, may be made of any metal which is sufficiently strong and has ample resistance to any chemicals employed in the process. Brass, bronze, phosphor-bronze, Monel metal, and nickel are among the materials in common use. Precautions are specially laid down for the protection and proper use of this wire. A glossary of terms is included.—W. A. C. N.

†**Copper and Health.** W. M. G. Schneider (*J. New England Water Works Assoc.*, 44, and *Cuivre et Laiton*, 1933, 6, 519-526).—A general record of investigations into the effect of copper in contact with various articles of food and in drinking-water. It is generally concluded that conduit pipes and containers of copper and of high copper-bearing alloys constitute no serious danger to health. Maximum permissible quantities of the metal in various media are quoted.—W. A. C. N.

Specifications for Brass Used in Wireless Manufacture. P. Mabb (*Machinery (Lond.)*, 1933, 42, 768-769).—Recommendations are given for the hardness, Erichsen value, and composition of sheet material suitable for various wireless components.—J. C. C.

Lead Alloys in Buildings. Anon. (*Chem. Eng. Mining Rev.*, 1933, 25, 45).—Short abstract of the research recently completed by the Department of Scientific and Industrial Research, Building Research. See *J. Inst. Metals*, 1933, 53, 459.—J. H. W.

Advances in the Use of Elektron and Hydronalium in Vehicle Construction.—Keinert (*Automobiltech. Z.*, 1933, 36, 628-629).—Abstract *in extenso* of a paper read before the Automobil- und Flugtechnische Gesellschaft, Berlin, Nov. 1933. Elektron castings find increasing application, especially as wheels, seats, and doors, whilst Hydronalium, highly resistant to corrosion and capable of taking a high polish, is suitable for parts much exposed to dirt or weathering.—P. M. C. R.

Nickel in Aeronautics. Pierre Blanchet (*Rev. Nickel*, 1933, 4, 103-118).—After reviewing the properties of various nickel-containing steels, B. proceeds to discuss the important nickel bearing non-ferrous alloys used in aviation. "Y" alloy is employed for pistons and the external vanes of cylinders, and "R.R." alloys for those parts which demand rigidity at elevated temperatures. Modifications of Duralumin are also used in addition to the above. In the ultra-light alloy class a magnesium alloy containing aluminium 8.5, nickel 0.7% is extensively used. It has an elastic limit of 16 kg./cm.², an ultimate stress of 29 kg./cm.², and elongation of 13%. The acute problem of corrosion of these latter alloys is a hindrance to their extensive adoption. Bronze alloys of the following types are brought into service for the manufacture of guides—(a) copper 88, aluminium 9.9.5, manganese 0.5, nickel 1.75-2.0%; (b) copper 80-84, aluminium 9-10, nickel 2-3, manganese 3-4, iron 2-4%. They have tensile strengths of approximately 65-75 kg./cm.² Cupro-nickels having minimum content of nickel of 50%, and of copper 30% find favour because of the inoxidizability, hardness over a wide range of temperature, absence of brittleness and expansion similar to that of the bronzes. Such alloys containing tin and silicon, with small proportions of iron, are also used. Pure nickel has been employed for exhaust and manifold tubes. Illustrations showing typical uses of these various alloys are given.—W. A. C. N.

Nickel in Automobile Construction. M. Godefroid (*Rev. Nickel*, 1933, 4, 125-136).—Of the non-ferrous alloys mentioned, the principal ones are: (a) cupro-nickels containing copper 60-70%; (b) white metals containing nickel 12, copper 40%; (c) copper-aluminium alloys containing copper 81, aluminium 10.5, iron 4.5, manganese 0.5, and nickel 3.5%; (d) aluminium alloys of the "Y" and R.R. classes; (e) electrodeposited nickel for external and internal fittings.—W. A. C. N.

Industrial Uses for Precious Metals. Anon. (*Eng. and Min. J.*, 1933, 134, 502).—Describes the use of gold and platinum to secure permanent pictorial and typographical records. Pictures are imprinted in platinum on a sheet of gold. Half-tone impressions are reproduced in polished platinum on a background of dull platinum.—R. Gr.

***A New Silver Filter for Ultra-Violet Light.** G. C. Brock (*Sci. Proc. Roy. Dublin Soc.*, 1933, 20, 563-566).—A thin film of silver, deposited by cathode sputtering, acts as a filter for light of wave-length 313 mμ. The action is attributed to the presence of colloidal silver, the particles of different sizes producing filters of different colours, all of which have a maximum of transmission near 300 mμ.—E. S. H.

Silvering and Re-Silvering Mirrors. Methods and Materials Needed. Abraham E. Lindy (*Decorator*, 1933, 32, 58).—Practical details of equipment, materials, and manipulation are given.—E. S. H.

Tantalum Spinnerets. Anon. (*Siemens Review*, 1933, 9, (3), 76).—Cites the application of tantalum for spinnerets in the manufacture of artificial silk.—R. Gr.

XXIII.—BIBLIOGRAPHY

(Continued from pp. 107-109.)

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XXIV.—BOOK REVIEWS

(Continued from pp. 110-112.)

The Principles of Metallurgy. By Donald M. Liddell and Gilbert E. Doan. Med. 8vo. Pp. vii + 626, with numerous illustrations. 1933. New York: McGraw-Hill Book Co., Inc. (\$5.50); London: McGraw-Hill Publishing Co., Ltd. (30s. net).

In the preface the authors state their belief in the importance of the development of the philosophy of metals, and in reading this treatise one feels that they have been successful in their attempt to impress this upon the reader. The book in many respects is different from other metallurgical text-books; the authors have given expression to a sense of individuality, and have not merely reiterated scientific facts and practical data. Some of the chapters are quite remarkable; for instance, the one dealing with air and water supply brings the reader into touch with a section of the subject which is important, but often neglected. In the description of plant, particularly with regard to crushing and grinding plant, simplified diagrams are given, which, whilst boasting of no elaboration, are just sufficient to impress upon the reader exactly what he wants. By augmenting these with actual photographs of plant, the difficulty of understanding the working of this type of machinery is completely overcome. The scientific aspect is well combined with the purely practical details, and one is impressed with the fact that metallurgy is a science, and not merely a craft. It is only natural that in a book of this length, although it covers more than 600 pages, a complete account of all metallurgical operations cannot be given, but the authors are to be congratulated upon their selection of material. The chapter on "The Metallic State" is of particular interest, and as in this section, like many others, most of the data referred to are of American or German origin, it is of great use to the English reader.

The application of X-rays to metallurgy is dealt with in a most excellent manner, and the effect of reading the interesting passages on this phase of the subject cannot but enthuse the student, and help him to create that very desirable faculty of imagination.

The chapter on slags, matte, bullion, and speiss is made extremely useful by the incorporation of many diagrams and physical data, and the same applies to several other chapters.

It may be said that in many respects the book is of outstanding merit, as it includes many sections of the subject which are omitted from the general text-book.

In conclusion, one feels that the authors must be congratulated on the excellent services they have rendered to metallurgical science in producing such a book. It cannot be regarded as an elementary text-book, and a previous knowledge of the subject is highly desirable if one is to enjoy to the full the interest of its contents. The paper, printing, and illustrations in general are excellent, and leave nothing to be desired.—J. H. ANDREW.

Aluminium and Its Alloys ; Their Production, Properties, and Applications.

By N. F. Budgen. Demy 8vo. Pp. xx + 278, with 150 illustrations. 1933. London : Sir Isaac Pitman and Sons, Ltd. (15s. net.)

Dr. Budgen is already well known as the author of books and papers on metallurgical subjects. In the volume under review he has attempted something quite different from his usual writings—namely, the presentation of the story of aluminium in a popular form. The work is comprehensive : it deals with the history of aluminium and the methods by means of which it is extracted from its ores, and follows the metal through all the processes of alloying and fabrication into the large variety of forms used at the present time. Almost every aspect of the metallurgy of aluminium is mentioned ; certainly no important section is overlooked. The author may be congratulated on having condensed so much into the short space of some 270 pages.

The work is not really a "popular" book in the widest sense of the word : indeed, it is to be doubted if a "popular" treatment of the subject on such comprehensive lines is possible in view of the complexity of the processes involved in this, as in almost all modern industries ; it, however, is semi-popular in the sense that it could be read with interest and understanding by most persons who have had some scientific or technical training. The least satisfactory portions of the book are those dealing with the metallography of the subject : the few equilibrium diagrams introduced are not adequately explained and it would probably be better to omit them altogether ; the photomicrographs of alloy structures, of which a considerable number is introduced, are in many cases not even referred to in the text, and must prove unintelligible to readers who have not had special training in metallography.

The chapters dealing with the heat-treatment of alloys ; founding ; melting plant ; rolling, drawing, forging, and extrusion ; and the uses of aluminium alloys, form an excellent concise account of the technology of the subject, and contain a great amount of useful information.

The book is well written and profusely illustrated, but in a large number of instances the illustrations are not adequately described in the text. In spite of the few defects referred to, the volume can be strongly recommended to all who take an interest in metallurgical subjects, and particularly to engineers, chemists, and others, who wish to obtain a broad but reliable picture of aluminium alloys which are entering more and more into our daily life.—D. HANSON.

The Alloys of Iron and Silicon. By Earl S. Greiner, J. S. Marsh, and Bradley Stoughton. (Alloys of Iron Research, Monograph Series.) Med. 8vo. Pp. xi + 457, with 124 illustrations. 1933. New York : McGraw-Hill Book Co., Inc. (\$5.00) ; London : McGraw-Hill Publishing Co., Ltd. (30s. net).

Although scarcely falling within the scope of publications usually reviewed in this *Journal*, this, the second monograph of the series, has obviously been compiled with the co-operation of so many collaborators of eminence, that the authoritative nature of the information recorded should be ensured and it will become a classic work of reference—a *sine qua non*—to all interested in the various phases of the subject dealt with.

The work should find a place in every reference library and the private libraries of those who wish to be in possession of the latest authoritative information on the alloys under review.

—H. B. WEEKS.

Mezinárodní Sjezd Slevárenský, Praha (International Foundry Congress, Prague), 1933. Pp. 576, illustrated. Prague : Czechoslovak Foundry Association. (Price : Kč. 100.)

This volume contains the 40 papers presented at the International Foundry Congress held at Prague in September 1933. The papers are all printed in Czech, and in at least one of the languages, English, French, and German ; unfortunately none of the papers has the discussion attached. In cases where the whole paper is not printed in English or German, there is a short summary in one or both of these languages at the head of the paper. The

subjects covered by the Congress are spread over a wide field, embracing cast iron, non-ferrous metals, moulding sands, furnaces, fuels and casting conditions, but most of the papers have a predominating ferrous interest. From the point of view of the non-ferrous foundryman, probably the most valuable paper is that on the castability of aluminium alloys with copper and magnesium by Portevin and Bastien, which is, in part, a continuation of work which has been recently described in the *Comptes rendus* and in the *Monthly J. Inst. Metals*, 1933, Dec., cccxxvi-cxxlvii. Various articles on moulding sands and foundry coke also have considerable non-ferrous interest.

The book is well printed on good paper, but unfortunately contains a very large number of misprints, especially in the English text. The English summaries are, on the whole, very poor, so that a working knowledge of French is necessary in order to appreciate the papers.

—A. R. POWELL.

Standard Methods of Analysis of Iron, Steel, and Ferro-Alloys. Med. 8vo. Pp. 35, interleaved for notes. 1933. Sheffield: The United Steel Companies, Ltd., 17 Westbourne Road. (4s. 6d. net.)

The methods described in this little book are those adopted as standard procedures by the laboratories of the various companies which make up United Steel Companies, Ltd. They cannot in any sense be described as "umpire" methods, but they should give results sufficiently accurate for most steelworks, although many chemists in such works would undoubtedly prefer alternative methods to those described for some elements, e.g. the persulphate method for chromium and manganese instead of the permanganate and bismuthate methods described, so as to avoid unnecessary filtrations. Only a colorimetric method is given for vanadium and the cyanide method, after a preliminary separation with dimethylglyoxime, for nickel. The elements discussed in the book are carbon, silicon, manganese, sulphur, phosphorus, nickel, chromium, tungsten, molybdenum, vanadium, titanium, cobalt, and arsenic; a method for aluminium in Alumin alloy is also given.

The book is written in very poor style, the details of the methods being given in the imperative mood and occasionally in the passive voice, both occurring sometimes in the same paragraph, and even in the same sentence. This cookery-book style degenerates occasionally into such sentences as "allow precipitates to settle on edge of hot plates." A few misprints, such as " Co_3C_4 " for " Co_3O_4 " and "managanese," have been noticed. The use of the terms ammonium hydrate and sodium hydrate for the corresponding hydroxides has long been obsolete, and they should therefore find no place in a modern text-book. Again, sulphocyanide, meta-vanadate, &c., should be written as one word without hyphen. The book has the appearance of being written by several authors with no attempt at co-ordination of style, but it may prove useful to steelworks' chemists, although their needs are already well catered for, and, in any case, they should be fully conversant with the procedures described.—A. R. POWELL.

Forschungsarbeiten auf dem Gebiete des Schweissens und Schneidens. Achte Folge. Herausgegeben im Auftrage des Deutschen Azetylenvereins von W. Rimarski. 4to. Pp. 119, illustrated. 1933. Halle (Saale): Carl Marhold.

Twenty papers on welding technology are included in this collection, and, of these, ten have no interest for the non-ferrous welder. The remainder includes: Hermann, "Left- or Right-Hand Welding" (see *Met. Abs.*, this volume, p. 39); Hoffmann, "Contribution to the Explanation of Fatigue Failure of Welded Joints"; Halberstadt, "X-Ray Pictures of Weld Seams" (see *Met. Abs.*, this volume, p. 95); Kochendörfer, "X-Ray Diagnosis in Welding Technology" (see *Met. Abs.*, this volume, p. 95); together with three papers on safety valves for high- and low-pressure pipe-lines, and, without which no work by Dr. Rimarski would be complete, two papers on explosions of gas mixtures.—H. W. G. HIGNETT.

Mechanical Catalogue and Index to Manufacturers of Industrial Equipment, Materials, and Supplies, 1933-34. Twenty-Third Annual Volume. 4to. Pp. xvi + 309. New York: American Society of Mechanical Engineers, 29 West 39th St.

This valuable reference work to American manufacturers of industrial equipment in metals of all kinds is now too well known to require detailed description. This new volume lives up to the reputation built up by its predecessors, and can be thoroughly recommended to all who have occasion to purchase this type of equipment from American manufacturers. The only new feature is that half-page advertisements are introduced for the first time to allow the smaller manufacturers or those making a speciality of only one or two articles to describe their products. The printing, illustrations, and index are of a high order of excellence.

—A. R. POWELL.