METALLURGICAL ABSTRACTS

(GENERAL AND NON-FERROUS)

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I.—PROPERTIES OF METALS

(Continued from pp. 481–493.)

***On the Source of the Copper in Virgin Aluminium.** A. Brenner and F. Wechtel (*Metallwirtschaft*, 1937, **16**, (40), 1009–1010).—The alumina contains 0·0007–0·007% copper, the electrodes 0·0001–0·001% copper, and the cryolite 0·0025% copper. The alumina is thus the chief source of the copper.—v. G.

***Surface Tensions of Molten Aluminium, Magnesium, Sodium, and Potassium.** V. G. Givov (*Trudi Vsesoiuznogo Aluminievogo-Magnievo Instituta* ("*VAMI*") (*Trans. Aluminium-Magnesium Inst.*), **1937**, (14), 99–112).—[In Russian.] The surface tensions of various metals determined by the bubble method in an atmosphere of argon were found to be as follows in ergs/cm.^{2}. : aluminium at 706° C., 494, at 935° C., 463 ; magnesium at 681° C., 563, at 894° C., 502 ; potassium at 79° C., 400·5, at 228° C., 391·5 ; sodium at 110° C., 205·7, at 263° C., 198·2. In each case the decrease in tension between the two temperatures given is linear.—D. N. S.

Physical Constants of Aluminium. Junius D. Edwards (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 922–929).—Discusses and gives data for atomic weight, crystal form, density, compressibility, thermal expansion, freezing point, specific heat, latent heat of fusion, boiling point, thermal conductivity, heat of combustion, fluidity, optical properties, electrical resistance, electrochemical equivalent, electrolytic solution potential, thermoelectromotive force, magnetic properties, and mechanical properties. A *bibliography* of 27 references is appended.—S. G.

Commercially-Pure Wrought Aluminium (2S). P. V. Faragher (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 928–929).—Briefly deals with sp. gr., temper designations, mechanical properties, corrosion-resistance, workability, welding characteristics, annealing treatment, and applications and forms produced.—S. G.

***An Apparatus for the Measurement of the Total Normal Thermal Emissivity of Sheet Materials in the Temperature Range 140° to 500° F. [Thermal Emissivity of Aluminium Foil, Chromium, Copper, Iron, Tin, and Zinc.]** Paul F. McDermott (*Rev. Sci. Instruments*, 1937, [N.S.], **8**, (6), 185–192).—Apparatus is described for measuring the total normal thermal emissivity of sheet materials up to ⅜ in. thick at 140°–500° F., with a limit of error of ± 1%, and without contact or damage to the surfaces. Values for aluminium foil and paint, chromium, copper, iron, tin, and zinc at 200° F. are tabulated. The values for bright aluminium foil are lower than those previously found, and are considered to be more accurate than the latter.—J. S. G. T.

***Evaporated Aluminium Films for Interferometer Plates for Use in the Ultra-Violet.** J. E. Ruedy and G. B. Sabine (*Bull. Amer. Phys.*, 1937, **11**, (2), 13–14).—See *Met. Abs.*, 1936, **3**, 338.—S. G.

***The Expansion Coefficients and Allotropy of Barium and Calcium.** P. G. Cath and O. L. v. Steenis (*Z. tech. Physik*, 1936, **17**, (7), 239–241).—The linear expansion coeffs. of barium and calcium were measured (in an argon atmosphere) between 0° and 300° C. The value for barium is very dependent on the previous thermal history of the specimen, and varies from 1·70 to 2·10 × 10^{-5}.

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* Denotes a paper describing the results of original research.
† Denotes a first-class critical review.

The rate of cooling of barium in high vacuum shows a discontinuity at 390° C., indicating the existence of two modifications. The coeff. for calcium is fairly constant at *c.* 2·20 × 10^{-5}, but a specimen heated for 2 hrs. at 400° C. showed an appreciable change in absolute length, which is ascribed to an allotropic change.—C. E. R.

***The Magneto-Resistance Effect in Cadmium at Low Temperatures.** Christopher John Milner (*Abstracts Dissertations Univ. Cambridge,* **1936–1937**, 139–140).—See *Met. Abs.*, this vol., p. 370.—S. G.

Physical Constants of Calcium. C. L. Mantell and Charles Hardy (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1015–1017).—A review of the literature, with data, and a *bibliography* of 17 references.—S. G.

Cerium-Group Metals: Manufacture, Properties, Uses. R. Strauss (*Metallwirtschaft*, 1937, **16**, (39), 973–975).—The recovery from monazite sand, and the properties and uses of cerium, lanthanum, neodymium, praseodymium, and samarium are described.—v. G.

***Investigations on Cobalt and the System Cobalt–Carbon.** (Meyer.) See p. 601.

†**The Physical Constants of Copper.** Cyril Stanley Smith (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1060–1067).—A review of the literature, with data, and a *bibliography* of 62 references.—S. G.

***The Physical and Mechanical Properties of Cold-Worked Copper.** A. Krupkowski and M. Balicki (*Ann. Acad. Sci. Tech. Varsovie,* 1936, **3**, 90–122).—(I.—) By experiments on copper wires of uniform diameter subjected to varied amounts of cold-working, it was shown that there is a close analogy between the variation of the physical and the mechanical properties of copper with the degree of cold-working. The curves showing the variation in properties as a function of the degree of cold-working exhibit three characteristic zones with limits at 27 and 65% cold-working. A fourth zone with a limit at 97% appears in the case of certain mechanical properties. Observation of the variation with temperature of the thermal e.m.f. of a couple consisting of annealed copper and copper cold-worked to different extents showed that the e.m.f. increases with increase in temperature up to the recrystallization point, and then becomes roughly constant at a value depending on the degree of cold-working. The recrystallization temperature and the thermoelectric power were thus determined as a function of the degree of cold-working. From a comparison between the variations with the degree of cold-working of thermoelectric power and the constants of elasticity, it was concluded that the thermoelectric power is a measure of the internal stress in the rolled metal. This stress has a great influence on the temperature of recrystallization. (II.—) In the second part of the work certain mechanical properties were studied for copper wires cold-worked to varying extent and then re-annealed at different temperatures. Wires corresponding to the fourth zone of cold-working (> 96–97%) showed an intercrystalline weakness, which did not disappear even after annealing at 600° C. Observation of the effect of the duration of the re-anneal on the temperature–e.m.f. curves of couples consisting of annealed and cold-worked copper wires afforded a new physical method for studying the relation between temperature of recrystallization and time of heating. It is shown that the phenomena of recrystallization may be explained by a theory of activation.—P. W. R.

***Endurance Tests on Electrolytic Tough-Pitch and Oxygen-Free Copper Wire.** J. N. Kenyon (*Wire and Wire Products,* 1936, **11**, (10), 576, 593; and (synopsis) *Met. Ind.* (*Lond.*), 1936, **49**, (21), 510).—A note on research in progress. From fatigue tests in progress on hard-drawn copper-wire specimens 0·080 in. in diameter, it is tentatively concluded that the oxygen-free material has a somewhat higher endurance limit and that the condition of the surface has less effect on the endurance limit of copper than of steel wire. A machine has been developed for fatigue tests on very thin wires, from 0·050 to 0·024 in. and less in diameter.—J. C. C.

Commercial Copper. H. C. Jennison and Cyril Stanley Smith (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1068–1074).—Discusses the various grades and forms of commercial copper and their mechanical properties, together with the influence of the various impurities or intentional additions that are often encountered, and the effect of such mechanical and heat-treatments as are customarily given. A *bibliography* of 29 references is appended.—S. G.

***Effect of Impurities in Copper.** (Archbutt and Prytherch.) See p. 705.

Physical Constants of Lead. James E. Harris (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1162–1167).—A review of the literature, with data, and a *bibliography* of 48 references.—S. G.

Crystallization, Creep, and Age-Hardening of Lead and Antimonial Lead. —— (*Metallurgist* (Suppt. to *Engineer*), 1937, **11**, 51–53).—A review of recently published work by N. Greenwood and his collaborators, in Australia, and by the Kaiser-Wilhelm Institut für physikalische Chemie und Electrochemie, in Berlin.—R. G.

Properties of Lithium and Its Alloys. Hans Osborg (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1188–1191).—Discusses the use of lithium as a refining agent and scavenger, and as an alloying element; the properties of lithium; and binary alloys of lithium with calcium, copper, and lead. The intermetallic compounds of lithium are tabulated, with melting points (where known). A *bibliography* of 4 references is appended.—S. G.

Physical Constants of Magnesium. Cyril S. Taylor and Junius D. Edwards (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1205–1209).—A review of the literature, with data, and a *bibliography* of 35 references.—S. G.

***Volume Changes During Solidification of Magnesium.** E. Pelzel and F. Sauerwald (*Metallwirtschaft*, 1937, **16**, (45), 1155).—The density of magnesium at high temperatures in the solid state was measured with a dilatometer, and in the liquid state by displacement. At the melting point, the solid metal has *d* 1·649 and the liquid metal *d* 1·585; hence a contraction of 3·97% occurs during solidification.—v. G.

***On the Transformations of Manganese.** Hiroshi Yoshisaki (*Sci. Rep. Tôhoku Imp. Univ.*, 1937, [ii], **26**, (2), 182–189).—[In English.] See abstract from periodical published in Japanese, *Met. Abs.*, this vol., p. 278.—S. G.

Physical and Mechanical Properties of Nickel. Paul D. Merica (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1257–1260).—Discusses the structure, gives values for the physical and technological properties, and tabulates the mechanical properties of the metal in various conditions. A *bibliography* of 19 references is appended.—S. G.

The Properties of Nickel. —— (*Nickel Bull.*, 1937, **10**, (1), 8–9; and *Monel Notes*, 1937, (2), 88–89).—The physical and mechanical properties are tabulated.—S. G.

***New Researches on the Recovery of Cold-Worked Nickel by Annealing.** Erich Fetz (*Rev. Mét.*, 1937, **34**, (9), 531–541).—The recovery, *i.e.* softening, of "Mond" nickel samples prepared in various ways, and hardened by rolling, was studied. For high-purity nickel, severely cold-worked, the softening temperature is in the range 300°–400° C., and not between 400° and 500° C. as previously recorded (Ransley and Smithells, Fetz). Impurities in commercially-pure nickel increase the softening temperature to 600° C. or higher, but hydrogen has the reverse effect. Nickel saturated with hydrogen during annealing shows lower hardness and lower softening temperature than nickel treated *in vacuo*. A specimen of fritted Mond nickel powder, reduced 90% by rolling, gave the abnormally low softening temperature of 283° C. when annealed in hydrogen. The results are discussed fully.—H. S.

***Recovery of Cold-Worked Nickel on Annealing.** Erich Fetz (*Amer. Soc. Metals Preprint*, **1937**, (Oct.), 27 pp.).—Additions of 0·25% tin and 0·25% and 0·75% silicon to nickel, prepared by sintering nickel carbonyl powder and annealing in hydrogen before cold-rolling, increase the recovery temperature by 200°, 100°, and 140° C., respectively. The effect of copper is slight, 0·75% causing only 50° C. increase. The temperature corresponding to a 50% loss of maximum hardness decreases linearly with increase of percentage reduction in rolling. Annealing the sintered metal specimens *in vacuo* or in nitrogen before rolling extends the recovery range, whilst the initial thickness affects the softening temperature; the recovery of " melted " and electrolytic nickel is unaffected by these factors. The forms of the curves relating temperature and time required for 50% recovery also differ. The effect of the rate of deformation is in all cases slight. The recovery temperature for " as deposited " electrolytic nickel and insufficiently annealed sintered nickel is 200°–300° C., as compared with 300°–400° C. for severely worked " melted " nickel. An experimental technique for establishing recovery temperatures is suggested.—G. V. R.

***On the Effect of the Gas Atmosphere During Annealing on the Edge Structure and Bending Properties of Nickel Sheet.** H. Winterhager (*Metallwirtschaft*, 1937, **16**, (27), 671–674).—Annealing of nickel sheet in carbon monoxide results in the formation of a homogeneous edge zone, which reduces only insignificantly the bending properties; hydrogen has no noticeable effect. Oxygen is deleterious only at high temperatures and after long times of exposure. When metal coated with an oxide film is annealed in hydrogen it becomes " hydrogen-sick," like copper. Chlorine attacks the metal at 600° C., forming a volatile chloride, which penetrates the grain boundaries; previous annealing of the metal in carbon monoxide at 900° C. retards the action of chlorine.—v. G.

***The Electrical Resistance of Ferromagnetics.** H. H. Potter (*Proc. Phys. Soc.*, 1937, **49**, (6), 671–678).—From measurements of the electrical resistance of nickel and iron at 20°–1200° K., it is concluded: (1) that the kink in the resistance–temperature curves at the Curie point is sharp to within a small fraction of a degree; (2) above the Curie point the curve is concave to the temperature axis as in a paramagnetic metal, *e.g.* palladium; and (3) the small change in spontaneous magnetization which occurs at low temperatures has a comparatively large effect on the resistance.—J. S. G. T.

***On Metal-Like Nickel Hydrides.** W. Büssem and F. Gross (*Metallwirtschaft*, 1937, **16**, (27), 669–671).—Evaporation of nickel in vacuum or in hydrogen yields deposits which always have a cubic structure; if, however, a glow discharge is passed through the hydrogen to produce atomic or ionic hydrogen, the deposits have a hexagonal lattice.—v. G.

***Diffusion of Electrolytic Hydrogen Through Metallic Palladium.** S. Makareva (*Zhurnal Fizicheskoy Khimii* (*J. Phys. Chem.*), 1934, **5**, 1380–1390; *C. Abs.*, 1935, **29**, 7743).—[In Russian.] With a current density of 0·004 amp./cm.^{2} at 20°–25° C., all the hydrogen evolved is found to diffuse through a 0·055-mm. palladium cathode when the outer surface of the latter is in contact with solutions of potassium dichromate, iodate, and ferrocyanide of concentration $> 0{\cdot}05N$. Only 10% diffuses through at a current density of 0·1 amp./cm.^{2}.—S. G.

Palladium, Iridium, Osmium, Rhodium, Ruthenium. F. E. Carter (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1281–1282).—The characteristics and uses of these metals are briefly discussed; their physical properties were dealt with elsewhere (abstract below).—S. G.

Platinum and the Platinum Metals. F. E. Carter (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1276–1280).—Discusses the grades and alloys, the uses of platinum alloys, and the care, use, and cleaning of platinum ware. The physical properties of the platinum metals are tabulated.—S. G.

Some Anomalies of the Potential of Iron and Some Other Metals [Platinum, Aluminium, Lead, Tin, Nickel, Zinc, Copper] in Hydrochloric and in Nitric Acid. Louis Guitton (*Bull. Soc. chim. France*, 1937, [v], 4, 570–580).—The potential of platinum against a saturated calomel electrode in hydrochloric acid increases from 0·32 v. in $10^{-5}N$-acid to 0·52 v. in $10^{-2}N$-acid, and then decreases with increasing acidity to 0·44 v. in $10N$-acid. In the dilute acid, hydrogen ions are adsorbed on the platinum surface, whereas in concentrated acid dissolution of the metal occurs in contact with air. For aluminium, the potentials corresponding to the above acidities are −1·2, −0·7, and −1·0 v., respectively. In nitric acid, the potentials of lead, aluminium, tin, and nickel are negative when the acid is dilute, but become positive with increasing acidity, until a maximum of 0·6–0·9 v. is obtained; in the fuming acid all the metals become passive. Values are also given for zinc and copper.—A. R. P.

***The Oligodynamic Effect of Silver.** Hans Fromherz (with Josef Heiss) (*Z. Elektrochem.*, 1937, **43**, (8), 561; discussion, 561).—Brief abstract (and discussion) of a paper read before the Deutsche Bunsen-Gesellschaft (see *Z. angew. Chem.*, 1937, **50**, July 10). The oligodynamic effect of silver was investigated by silver ions which escape from the metal. The escape of these ions from the metal was not detected in pure insulated silver wires. It always takes place over the whole metal surface if the silver wire is contaminated in any one place with a silver salt. The exhaustion of the oligodynamic effect of a silver wire depends on the complete using-up of the contamination by the silver salt, especially of silver oxide.—J. H. W.

***Studies in Contact Potentials. The Condensation of Potassium and Sodium on Tungsten. [Vapour Pressure of Sodium.]** R. C. L. Bosworth and E. K. Rideal (*Proc. Roy. Soc.*, 1937, [A], **162**, (908), 1–31).—The use of contact potential measurements for the examination of the properties of films on metal surfaces is discussed, and the necessary experimental conditions are indicated. Experiments are described on films of sodium and potassium deposited on clean tungsten and on tungsten surfaces previously covered with oxygen or hydrogen. In all cases the dipole moments of the anions decrease with increasing film concentration. A comparison with thermionic and photoelectric data is made. A study is also made of the adsorption of hydrogen on tungsten surfaces partially covered with potassium. From the rate of change of surface potential when the filament is exposed to sodium vapour, the pressure of the vapour may be determined, and the vapour pressures of solid and liquid sodium may be expressed by the equations: $\log p_{(\text{solid})} = 7{\cdot}68 - 5410/T$ over the range 285°–370° K., and $\log p_{(\text{liquid})} = 7{\cdot}26 - 5248/T$ over the range 370°–443° K., where p is expressed in mm. of mercury.—W. H.-R.

***Studies in Contact Potentials. The Evaporation of Sodium Films.** R. C. L. Bosworth (*Proc. Roy. Soc.*, 1937, [A], **162**, (908), 32–49).—The contact-potential method of Bosworth and Rideal (preceding abstract) is applied to the study of films of sodium on tungsten at high temperatures. The heat of evaporation of sodium from a very dilute film on tungsten is 32,000 cal., but as the film concentration increases, this value steadily decreases to 17,000 cal. for the film of minimum work-function; the latter value is less than the heat of evaporation (25,000 cal.) of solid sodium, so that at still higher film concentrations the latent heat of evaporation increases. When a sodium atom is brought up to a clean tungsten surface, ionization occurs, and the resultant ion is adsorbed by electrostatic forces; the reaction $\text{Na} + W = \text{Na}^+ + W^-$ is exothermic to the extent of 0·5 e.v. (W here indicates the tungsten surface). At higher temperatures, a small proportion of the adsorbed ions are activated and lifted out of the plane of the remainder. Evidence is given that films of certain thicknesses are unstable, and tend to split up into phases of higher and lower concentration.—W. H.-R.

Physical Constants of Tin. C. L. Mantell (*Metals Handbook* (*Amer. Soc. Metals*), 1936, 1303–1309).—A review of the literature, with data, and a *bibliography* of 67 references.—S. G.

***Precision Extensometer Measurements on Tin.** Bruce Chalmers (*J. Inst. Metals*, 1937, **61**, 103–118; discussion, 119–122).—A precision extensometer, reading by means of optical interference fringes to strains of 10^{-7} cm./cm., is used for creep experiments on tin. The results are given under 3 headings: (*a*) single crystals; (*b*) specimens consisting of a few crystals with longitudinal crystal boundaries; and (*c*) specimens consisting of small crystals. The results show that the change of orientation across a crystal boundary affects the mechanical properties of the boundary, and the relation between recovery and creep, and the forms of the creep curves are discussed.—B. C.

***The Influence of Difference of Orientation of Two Crystals [of Tin] on the Mechanical Effect of Their Boundary.** Bruce Chalmers (*Proc. Roy. Soc.*, 1937, [A], **162**, (908), 120–127).—Cylindrical specimens of tin were prepared, consisting of two crystals with a longitudinal boundary in the direction of the axis of the test-piece. The preparation was by the moving-furnace method, and the seed crystals were adjusted so that the crystal lattices were similarly orientated with respect to the axis of the specimen, not only for the two crystals comprising one specimen, but from specimen to specimen; the 001 axis was perpendicular, and the 101 axis at 45° to the axis of the specimen. This symmetry about the axis ensures that the resolved shear stress is the same on corresponding planes in different cases, but leaves the angle A between the 001 axes of the crystals under control. The specimens were then tested in tension, and the critical tension required to produce a small arbitrarily-defined extension varied regularly with the angle A, being a minimum for $A = 0$ (*i.e.* a single crystal), and a maximum for $A = 90°$. C. concludes that the boundary has no inherent strength, and that the results are best explained as the effect of a transitional lattice. The evidence is against the existence of an amorphous layer or intercrystalline cement.
—W. H.-R.

***Interactions Between Gases and Metals [Copper, Tungsten].** Allan Bishop van Cleave (*Abstracts Dissertations Univ. Cambridge*, **1936–1937**, 127–128).—(1) *The catalytic union of hydrogen and oxygen on copper and copper–gold alloys.*—See *Met. Abs.*, this vol., p. 482. (2) *The adsorption of gases* [*oxygen and nitrogen*] *on tungsten.*—The existence of two distinct oxide films is confirmed: the second, a molecular layer, is formed on top of the first W–O film. Evidence that nitrogen behaves similarly has been obtained.—A. G. D.

Physical Constants of Zinc. E. A. Anderson, M. L. Fuller, and R. T. Craig (*Metals Handbook* (*Amer. Soc. Metals*), 1936, 1340–1345).—A review of the literature, with data, and a *bibliography* of 53 references.—S. G.

***Deformable Titanium and Zirconium.** W. Kroll (*Z. anorg. Chem.*, 1937, **234**, (1), 42–50).—See also *Met. Abs.*, this vol., p. 436. Titanium and zirconium can be obtained by reduction of their oxides with metallic calcium in a fused barium–calcium chloride flux at 1000° C., in an atmosphere of purified argon. The fused mass is crushed and digested with hot water and dilute hydrochloric acid, the heavy black metallic powder is washed free of salts and colloidal material by decantation, dried, and mixed with calcium hydride powder, and the mixture is heated in argon with the same flux as before. The metal powder from this second process is relatively pure, but still contains a small amount of lower oxide, which cannot be removed by any metallic reducing agent; the powder can, however, be compressed into slugs, which, after sintering *in vacuo*, can be hot-forged or hot-rolled above

200° C. Attempts to purify titanium by dissolving it in molten zinc (solubility 12%) or molten tin or lead (solubility 10%) and then distilling off the volatile metal *in vacuo* failed, since the titanium liberated reacted with every refractory tried. No success was obtained in attempts to produce workable metal by reducing double fluorides with sodium.—A. R. P.

***Thermionic Approximations to the Gas-Covered Fraction of an Adsorbing Surface, Applied to the Temperature Dependence of Oxygenation and Oxidation of a Tungsten Filament.** M. C. Johnson and F. A. Vick (*Proc. Phys. Soc.*, 1937, **49**, (4), 409–418; discussion, 418).—S. G.

***On the Energy States of Valency Electrons in Some Metals. I.—Some Regularities Existing in Crystal Level Values and Those of Atomic Spectrum of Zinc.** Mituru Satô (*Sci. Rep. Tôhoku Imp. Univ.*, 1937, [ii], **26**, (2), 207–213).—[In English.] See also *Met. Abs.*, this vol., p. 427.—S. G.

***The Mechanical Properties of Some Metals and Alloys Broken at Ultra-High Speeds.** D. W. Ginns (*J. Inst. Metals*, 1937, **61**, 61–72; discussion, 73–78).—The mechanical properties of carbon steels, copper, brasses, and aluminium alloys were investigated when broken in tension at very high speeds. The average time taken to reach the yield-point is 0·001 second, and to fracture 0·005 second. A pressure-resistance method was used for measuring stress, and a photo-cell method for strain, the two being combined to give a direct diagram on the cathode-ray oscillograph. It is shown that, compared with the ordinary commercial tensile test values: (*a*) the yield-point is increased very considerably, over 100% increase being recorded for some materials; (*b*) the maximum stress is increased by a much smaller amount; (*c*) the percentage elongation and the percentage reduction of area show comparatively small changes; (*d*) the types of fracture are almost identical with those obtained for the slow test.—D. W. G.

***A Study of the Damping Characteristics of an Elastic Vibration.** Seiichi Higuchi (*Sci. Rep. Tôhoku Imp. Univ.*, 1937, [ii], **26**, (2), 236–242).—[In English.] Mathematical.—S. G.

The Friction of Sliding Metals. F. P. Bowden with L. Leben (*Inst. Mech. Eng. General Discuss. on Lubricants, Advance Copy*, **1937**, (Group IV), 40–44).—(I.—) The surface temperature, measured by using the rubbing contact of two different metals as a thermocouple, is dependent on the load and speed of sliding, and may reach the melting point of one of the metals. Graphs are given showing the surface temperatures developed by lead and Constantan sliding on mild steel. The flow and seizure of metal surfaces is greatly influenced by the relative melting points of the polisher and the solid, and is not influenced by the hardness. Such considerations as the foregoing are applied to the behaviour of bearing metals. The properties of metals at high temperature and the surface tension have an important effect on the behaviour of a bearing. (II.—) The nature of sliding, and the measurement of fluctuating friction and of fluctuating temperature are dealt with. The process of sliding is considered to be not necessarily continuous, but a process of "stick, slip," with corresponding violent fluctuations of frictional force and surface temperature.—R. Gr.

Condition of Metallic Surfaces: Its Classification and Its Influence on Resistance to Fatigue. Paul Bastien (*Mécanique*, 1937, **21**, (274), 211–214).—The desirability of classifying the finish of metallic surfaces is emphasized as an aid to mechanical, metallurgical, and physico-chemical studies. Methods of classification are summarized and discussed; they include direct and indirect mapping processes, and measurements of properties dependent on surface condition (reflectivity, electrostatic capacity, rate of air flow). The influence on fatigue strength of the geometrical character of the surface, and of its physical and chemical relationships is discussed.—P. R.

The Surface Condition of Metals. A. Portevin (*Mécanique*, 1937, 21, (274), 216–217).—Contribution to a discussion by the Société Française des Mécaniciens (Section "Mécanique de Précision et Métrologie"). Both the geometrical form and the actual constitution of the surface constituents of a metal specimen differ from the theoretical, and physical, chemical, and geometrical modifications are further produced by any type of finishing process.—P. R.

***On the Application of Electrode Potentials to the Determination of the Critical Points of Metals and Alloys [Nickel, Iron, Zinc, Thallium, Tin, and Certain Copper–Gold and Cadmium–Magnesium Alloys].** (Śmiałowski). See p. 623.

Thermal Agitation in Solids and Liquids, and the Theory of Fusion. J. I. Frenkel (*Izvestia Akademia Nauk S.S.S.R.* (*Bull. Acad. Sci. U.R.S.S.*), 1936, [Phys.], (1/2), 371–393; and *Uspehi Fizicheskih Nauk* (*Prog. Phys. Sci.*), 1936, 16, (7), 955–976).—[In Russian.] Cf. *Met. Abs.*, 1936, 3, 497. A theoretical investigation, stressing the continuity of the transformation from the liquid into the solid state.—N. A.

***On the Rate of Melting.** G. Tammann (*Metallwirtschaft*, 1937, 16, (26), 626–629).—In the vicinity of the melting point, the rate of melting or crystallization is limited by the quantity of heat supplied or removed, respectively, and is therefore proportional to the ratio of the heat conductivity to the latent heat of fusion. The rate of melting can be determined by measurement of the shortening of a rod heated at one end and by measurement of the volume change during melting. Overheating does not, therefore, occur in the vicinity of the melting point, but only when the heat supplied exceeds the latent heat of the molten part; a similar consideration applies to undercooling. The rate of melting of some eutectic alloys (lead–tin, cadmium–zinc, and silver–copper) was determined by measuring the shortening of two rods of the constituent metals pressed together; the liquid obtained had approximately the eutectic composition, unless there was a great difference in the heat conductivities of the metals, in which case the melt contained an excess of the better heat conductor.—v. G.

†Classification of Metallurgical Processes with Special Reference to the Part Played by Gases. R. Schenck (*Z. Elektrochem.*, 1937, 43, (7), 438–450; corrections, (10), 826).—S. discusses the equilibrium diagrams for many processes in which a gas plays the part of an oxidizing or reducing agent, and those involving the evolution or absorption of a gas, whether they are employed in practical metallurgical processes or not. Amongst the many examples considered may be mentioned the systems involving manganese and nitrogen; chromium and carbon; nickel, lead or copper and sulphur.—L. E. P.

***The Theory of the Removal of Gases from a Metal at High Temperature.** I. A. El'tzin (*Zhurnal Eksperimentalnoy i Teoreticheskoy Fizikii* (*J. Exper. Theoret. Physics*), 1935, 5, 176–182; *C. Abs.*, 1935, 29, 7781).—[In Russian.] On the assumption that gases arise in metals as a result of chemical reactions, a theory is developed for the evacuation of gas from metal layers at high temperatures. The formula was verified experimentally by studies on the evolution *in vacuo* of gases from sheets of tool steels, 0·5 mm. thick, at 750°–1000° C.—S. G.

***The Effect of Gases on Metals.** A. Portevin, G. Chaudron, and L. Moreau (*Metallurgist* (Suppt. to *Engineer*), 1937, 11, 54).—A summary of a paper in *Compt. rend.*, 1937, 204, (17), 1252–1254; see *Met. Abs.*, this vol., p. 279. —R. G.

***The Problem of Degassing and Refining Metals and Alloys.** Henry Lepp (*Rev. Mét.*, 1937, 34, (7), 443–446).—Solubility of oxides in industrial metals in the solid state is negligible, or very limited. L. considers that "oxidized metal," as known in foundries, is due to the simultaneous presence of oxides and reducing gases. The effect of different gases on metals is considered in relation to thermochemical equations and Le Chatelier's principle, and also as regards concentration in relation to the law of mass action, and displacement of equilibrium with temperature in relation to Nernst's equation. Known methods of deoxidation are considered in relation to the thermodynamics of gas-metal systems. Treatment with acid fluxes moves the equilibrium towards enrichment of the metal with gas. L. proposes selective oxidation by agents so chosen that only undesirable substances are oxidized in the main. The choice is based on availability of the oxygen at the temperature of the molten metal, and the course of the thermal reaction between oxygen and the impurity concerned. A very fluid flux is required in cases where the oxide formed remains in suspension in the melt. A less harmful element is necessarily present in the bath to avoid oxidation of the basis metal, and the former should possess a certain vapour pressure at the melting temperature concerned. Results are given of tensile tests of metals and alloys treated industrially, but without details of the particular treatments applied.—H. S.

***The Process of Oxidation of Liquid Metals at Elevated Temperatures.** A. Krupkowski and S. Balicki (*Métaux et Corrosion*, 1937, **12**, (141), 89–95).—The oxidation of liquid metals in various atmospheres was measured by heating the specimens in a crucible attached to one arm of a balance. If the metals are covered by solid oxide at the given temperature, the oxidation conforms to the parabola, $w^2 = kt$. As the process proceeds, the rate of oxidation diminishes considerably. Zinc and lead belong to this group. If the metals have large powers of absorption of oxygen, or are covered with liquid oxide, the oxidation conforms to the straight line, $w = kt$. At a given temperature the rate of oxidation is constant and considerable, so that experimental conditions greatly influence the oxidation. Silver and copper belong to this group.—J. H. W.

***Transformations Produced in Certain Metals by Heating *in Vacuo*, Inert Gases, or Air.** J.-J. Trillat (*Métaux et Corrosion*, 1937, **12**, (137), 6–8).—Surface alteration of metals by various actions (oxidation, corrosion, gas adsorption, polishing, &c.) were studied by electron diffraction; in particular, the annealing of extra thin (50 μμ) metallic leaf at a given temperature in pure gases and *in vacuo* was investigated. For certain metals (gold and silver) there exists a surface dimorphism, which appears only on heating, and exists only within given temperature limits. In gold leaf containing traces of copper, and owing to its porosity, a compound resembling an interstitial solid solution with oxygen can be formed. Other metals (aluminium, copper, iron) give stable oxides which are not decomposed by the action of heat *in vacuo*, but platinum shows no modification. 5 references are given.—J. H. W.

On the Vapour Pressure of Metals. Tsutomu Kase (*Denkiseiko* (*Elect. Steel Manuf.*), 1937, **13**, (1), 1–9).—[In Japanese.]—S. G.

***The Problem of the Compressibility of Metals.** V. T. Saveliev (*Zhurnal Eksperimentalnoy i Teoreticheskoy Fiziki* (*J. Exper. Theoret. Physics*), 1936, **6**, (10), 1075–1082).—[In Russian.] Approximate lattice constants and compressibilities of several metals were calculated, and their dependence on the valency and atomic number of the element was determined without using empirical data.—N. A.

***The Electronic Specific Heat and X-Ray Absorption of Metals, and Some Other Properties Related to Electron Bands.** H. Jones and N. F. Mott (*Proc. Roy. Soc.*, 1937, [A], **162**, (908), 49–62).—The Brillouin zones in body-centred and face-centred cubic crystals are discussed, and curves are given showing the density of electron states for the two structures. The electronic specific heat is calculated for a number of metals. In metals with closed *d* shells it is shown that the linear term for the electron specific heat is in general greater than that given by Sommerfeld's free-electron formula. The densities of electron states in the *d* bands of transition elements are investigated, and their relation with the electronic specific heat, magnetic susceptibility, resistance at high temperatures, and integrated thermoelectric power are discussed. The fine structure of the X-ray absorption edges in metals is discussed.—W. H.-R.

***Metallic Reflection and the Surface Photoelectric Effect.** R. E. B. Makinson (*Proc. Roy. Soc.*, 1937, [A], **162**, (910), 367–390).—Theoretical. Using the Sommerfeld model of a metal, a classical calculation of the field of an incident light-wave (near the surface) gives to a close approximation the same results as the quantum theory of metallic reflexion of Schiff and Thomas (*Met. Abs.*, 1935, **2**, 380). An expression is obtained for the photoelectric current arising at the surface of such a metal, and the calculated and experimental values are compared for potassium, and the differences discussed; the effect of small-scale surface roughness is also discussed.—W. H.-R.

***Secondary Electron Emission from Complex Surfaces.** L. R. G. Treloar (*Proc. Phys. Soc.*, 1937, **49**, (4), 392–407; discussion, 408).—S. G.

†**Determination of the Number of Free Electrons in Metals from Their Mean Free Paths.** L. Riedel (*Metallwirtschaft*, 1937, **16**, (26), 634–640).—Theoretical deductions.—v. G.

***Magnetic Properties of Supraconducting Metals and Alloys.** L. V. Shubnikov, V. I. Hotkevich, U. D. Shepelev, and U. N. Rjabinin (*Zhurnal Eksperimentalnoy i Teoreticheskoy Fiziki* (*J. Exper. Theoret. Physics*), 1937, **7**, (2), 221–237).—[In Russian.] Measurements were carried out on polycrystalline lead and mercury, on single crystals of lead and tin, and on lead–thallium, lead–bismuth, lead–indium, and mercury–cadmium alloys, and the results are shown graphically. In solid-solution alloys induction depends on field strength up to a certain value of which (H_{K1}) the permeability is practically nil; as the field strength is further increased the permeability also increases and approaches unity at a value H_{K2}. The value ($H_{K2} - H_{K1}$) increases with increasing concentration of solute metal. These phenomena cannot be explained by hysteresis effects, since they can be obtained both in an increasing and in a decreasing field, the hysteresis effect being quite small.—N. A.

***Experiments on Supraconductors [Tin] in Alternating Magnetic Fields.** J. G. Daunt (*Phil. Mag.*, 1937, [vii], **24**, (161), 361–377).—Long hollow cylinders of very pure tin were placed in an alternating magnetic field of the order 1 gauss, at very low temperatures. When the specimen was in the supraconductive state, it completely shielded the inside from any changes of field. When supraconductivity was destroyed by applying an external d.c. magnetic field at constant temperature, the exterior alternating field could penetrate the wall of the cylinder, and was detected by suitable amplifying methods. In this way the disturbance of supraconductivity by a magnetic field was studied, hysteresis effects being noted, and the behaviour of the material investigated when both normal and supraconducting regions existed. The progress of the transition with time was also studied.—W. H.-R.

Resistance Variation in Ferromagnetic Crystals. R. Gans and J. von Harlem (*Ann. Physik*, 1932, **15**, (5), 516–526; *Sci. Abs.*, 1933, [A], **36**, 301).—The behaviour of single crystals of ferromagnetic substances in a magnetic field is discussed theoretically, and is compared with experimental results. The treatment is based on two principles used by Heisenberg: (1) the conditions of symmetry of the magnetically-saturated crystal are taken into account; and (2) use is made of the hypothesis that the elementary regions of an unsaturated crystal are also saturated, but the directions of the magnetization in the individual elementary regions may be different. The theoretical results are found to accord well with the experimental determinations.—S. G.

Magnetostriction of Ferromagnetic Crystals. R. Gans and J. von Harlem (*Ann. Physik*, 1933, **16**, (2), 162–173; *Sci. Abs.*, 1933, [A], **36**, 648).—The change of length of single crystals of iron and nickel in a magnetic field can be treated according to the same principles as have been used by G. and H. in dealing with changes in resistance. The problem has been discussed for the case of saturated crystals by Akulov, and for non-saturated by Heisenberg, but the assumption which results from the principle of symmetry is only a first approximation. The authors therefore reconsider the problem, particularly as regards the transverse effects, which cannot be taken over directly from the previous formulæ, owing to the manner in which the experiments have been arranged. It is found that the same h combinations as result from the saturation measurements are decisive for the magnetostriction in the unsaturated state, so that it is possible to predict the phenomenon in the unsaturated state, and to compare it with the results of experiment. Heisenberg's hypothesis is found to give as satisfactory results as can be expected.—S. G.

***Mechanostriction and ΔE Effect.** N. Akulov and E. Kondorsky (*Z. Physik*, 1933, **85**, (9/10), 661–671; *Sci. Abs.*, 1933, [A], **36**, 1348).—The distribution function for elastically-strained crystals possessing 3 or 4 axes of easy magnetization is derived, and applied to the calculation of the various magnetomechanical properties of single crystals of nickel and iron, as well as polycrystals. The general formulæ for calculating the mechanostriction and the ΔE effect are deduced, and a chosen connection between the two effects is found. The theory agrees with the results of experiment.—S. G.

***Domain Theory of Ferromagnetics Under Stress.—I.** William Fuller Brown, Jr. (*Phys. Rev.*, 1937, [ii], **52**, (4), 325–334).—Theoretical. The statistical domain theory of Heisenberg (*Met. Abs.*) (*J. Inst. Metals*), 1931, **47**, 374) and others is developed in a general form, capable of application to any ferromagnetic substance in the single-crystal or polycrystalline condition. General formulæ are obtained by which the strains (or stresses) and certain other quantities can be calculated as functions of the magnetization, and to the first order in the stresses (or strains) provided that the magnetization curve at zero stress is known. The analysis is valid at any magnetization below that at which the rotation process begins, and the 6 stress components may have arbitrary values. The formulæ are applied to nickel crystals, and the results reduce to those of Gans and von Harlem (abstracts above) and Akulov and Kondorsky (*Met. Abs.* (*J. Inst. Metals*), 1933, **53**, 119; and preceding abstract), except for two cases where mistakes in the earlier theories are found and corrected.—W. H.-R.

II.—PROPERTIES OF ALLOYS

(Continued from pp. 493–506.)

Constitution of Aluminium–Chromium Alloys. W. L. Fink and H. R. Freche (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 905).—A brief review of the literature, with the authors' own diagram (*Met. Abs.*, 1934, **1**, 168) for the aluminium-rich alloys.—S. G.

†**Constitution of Aluminium–Copper Alloys.** E. H. Dix, Jr., and H. H. Richardson (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 906–907).—A brief, critical review of the literature, with a *bibliography* of 11 references. The diagram of Stockdale (*J. Inst. Metals*, 1933, **52**, 111) is reproduced, modified in the range 0–6% copper to agree with the results of D. and R. (*J. Inst. Metals*, 1926, **35**, 535).—S. G.

Properties of Aluminium–Copper Alloys. E. H. Dix, Jr., and J. J. Bowman (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 930–931).—Deals briefly with the casting characteristics and mechanical properties of the casting alloys, rolling characteristics, and mechanical properties of wrought alloys, corrosion-resistance, density, thermal and electrical conductivities, thermal expansion, and endurance limit. A *bibliography* of 13 references is appended.—S. G.

***On the Mechanical Properties of Light Aluminium–Copper Alloys.** W. Broniewski and A. Pilko (*Ann. Acad. Sci. Tech. Varsovie*, 1936, 3, 231–237).—The mechanical properties of aluminium–copper alloys containing up to 13 weight-% of copper were measured after annealing at 350°, tempering at 525°, and ageing at 185° C. The tensile strength, elastic limit, extension, constriction, hardness, and resilience were measured and the Brinell coeff. and work of fracture calculated for each specimen. The tempering affects the tensile strength, elastic limit, constriction, and hardness of alloys with more than 1% copper, the same properties being affected by the ageing process in alloys with more than 3% copper. The extension is not affected by tempering or ageing below 5 or 6% copper. The resilience is affected by tempering in alloys with more than 1% copper, but the subsequent ageing seems to have little effect on this property. This heat-treatment appears to produce an optimum effect in alloys containing from 5 to 6% copper, the tensile strength reaching 40 kg./mm.^{2} with an extension of 20%, a Brinell hardness of 90, a resilience of 1 kg., and a work of fracture of 8 kg. In alloys with from 7 to 8% copper the tensile strength reaches 46 kg./mm.^{2}, but the extension is reduced to 10%. Thus, the light aluminium–copper alloys, subjected to the appropriate heat-treatment, attain and even surpass the mechanical properties of Duralumin.—P. W. R.

Properties of Heat-Treated Aluminium–Copper (4%) Casting Alloys. H. J. Rowe (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 934–935).—The general properties and uses of these alloys are briefly discussed, and a table is given of the physical properties of the alloy with 3 different heat-treatments, conforming to several American specifications.—S. G.

***Note on the Effect of Silicon on the Mechanical Properties of 7 Per Cent. Copper–Aluminium Alloy (L11).** T. H. Schofield, C. E. Phillips, and S. L. Archbutt (*J. Inst. Metals*, 1937, 61, 79–82).—A summary is given of an investigation of the effect of silicon on the mechanical properties of 7% copper–aluminium alloy (L11). In general, there is a slight improvement, except in the Izod impact value, with the addition of silicon up to 1%. With more than 1% silicon the effect is less definite, although the proof stress continues to increase with increase of silicon to 2%.—T. H. S.

Properties of Aluminium–Copper (8%) Casting Alloys (12, 112, 212). H. J. Rowe (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 932–933).—The general properties and uses of these alloys are briefly discussed, and a table is given of the physical properties for 3 compositions, conforming to several American specifications.—S. G.

***Influence of Titanium on the Structure and Mechanical Properties of Duralumin.** S. M. Voronov and M. G. Kasheev (*Aviopromishlennost* (*Aero. Ind.*), **1937**, (6), 40–46).—[In Russian.] Addition of a small amount of titanium to complex aluminium alloys produced grain-refinement only if the metal is heated to 850°–900° C. before casting. Heating to 750°–800° C. produces very little grain-refinement, since the $TiAl_3$ is not completely dissolved at this temperature and appears in the casting as coarse, irregularly-distributed crystals. Hence, addition of titanium to aluminium alloys which are melted under generally-accepted conditions not only produces no useful results, but is distinctly objectionable.—N. A.

***Influence of Iron and of Small Amounts of Magnesium on the Ageing of Aluminium–Copper Alloys.** D. A. Petrov (*Metallurg* (*Metallurgist*), **1937**, (5), 119–126).—[In Russian.] Very small amounts of magnesium (0·03%) completely restore the age-hardening capacity of aluminium alloys at room temperature. The presence of traces of magnesium in certain samples of commercial aluminium explains the different results obtained by different investigators in the study of the ageing of technical copper–aluminium alloys. When the iron content is high enough, the insoluble compound Al_7Cu_2Fe is formed, which results in a decrease of ageing capacity, even if the alloy contains magnesium. The presence of about 2% iron entirely prevents ageing in 4% copper–aluminium alloy.—N. A.

***Study of Tough and Corrosion-Resistant Aluminium Bronzes.** Tomojiro Tanabe and Goro Koiso (*Japan Nickel Rev.*, 1937, **5**, (4), 566–571).—[In English and Japanese.] Summary from *Tetsu to Hagane*, 1937, **23**, (5), 439–447 (in Japanese); see abstract from another source, *Met. Abs.*, this vol., p. 329).—S. G.

Wrought Aluminium Bronzes. Jerome Strauss and Lewis H. Fawcett (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 936–938).—The properties, uses, compositions, and manufacture of these alloys are briefly discussed. A table gives the properties of 19 special aluminium bronzes in various forms and conditions.—S. G.

Cast Aluminium Bronzes. Jerome Strauss and Lewis H. Fawcett (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 939–941).—Briefly discusses the composition, applications, manufacture, and mechanical properties, with 10 *references*—S. G.

Properties of Aluminium–Copper–Iron–Magnesium Alloy (122 or S.A.E. 34). O. H. Heil (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 957–958).—The properties of the alloy " 122 " are given for two heat-treatments, and curves show the hardness and tensile properties at elevated temperatures. The general properties and uses are briefly indicated.—S. G.

Properties of Aluminium–Copper–Magnesium Manganese Alloy (17 S or Duralumin). P. V. Faragher (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 959–960).—The composition, properties, temper designations, workability, welding, heat-treatment, and commercial forms are briefly discussed. A table gives typical mechanical properties for 5 tempers and for Alclad sheet in 2 tempers.—S. G.

Wrought Aluminium–Copper–Magnesium (1·5%)–Manganese Alloy (24 S). T. W. Bossert and J. A. Nock, Jr. (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 961–962).—The composition, properties, temper designations, workability, welding, solution heat-treatment, annealing, forms, and applications are briefly discussed. A table gives the properties of the alloy and of Alclad 24 S sheet, each in 3 tempers.—S. G.

Properties of Aluminium–Copper–Nickel–Magnesium Alloy (142 or Y Alloy). O. H. Heil (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 963–964).—A table gives the physical properties of Y-alloy; the tensile properties and hardness at elevated temperatures are shown by curves.—S. G.

†**Constitution of Aluminium–Iron Alloys.** E. H. Dix, Jr. (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 908–909).—A brief, critical review of the literature, with a *bibliography* of 8 references. A diagram is given, based on the work of Gwyer and Phillips and of Dix.—S. G.

***On the System Aluminium–Iron–Silicon.** Walter Jäniche (*Aluminium-Archiv*, 1936, (5), 21 pp.).—Dissertation, Berlin. The aluminium-rich corner of the system aluminium–iron–silicon up to 40% iron and 30% silicon was investigated by thermal analysis and X-ray and micrographic examination. Four ternary phases were established, belonging to the hexagonal, rhombic, triclinic, and tetragonal systems, respectively. The tetragonal phase corresponds with Al_4Si_2Fe. The solubility of the ternary α-phase was determined at 550°, 450°, and 300° C.—P. W. R.

***Investigations on Aluminium–Lithium Alloys.** H. Vosskühler (*Metallwirtschaft*, 1937, **16**, (36), 907–909).—The solubility of lithium in aluminium (determined by electrical resistance measurements) is 5·2 weight-% at 600° C., 3·6% at 550° C., 2·5% at 500° C., 1·7% at 400° C., and 0·9% at 220° C.; the values for lower temperatures are smaller than those previously assumed. The lattice parameter of aluminium is decreased by 0·003 A. on addition of lithium, while the hardness increases to 90 kg./mm.^{2} in quenched alloys with 6·7% lithium, and to 135 kg./mm.^{2} after reheating at 175° C. The resistance to corrosion is equal to that of magnesium–aluminium alloys so long as the lithium content does not exceed 5·2%.—v. G.

†**Constitution of Aluminium–Magnesium Alloys.** E. H. Dix, Jr., and F. Keller (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 910–911).—A brief, critical review of the literature, with a *bibliography* of 10 references. A diagram is given, based on the work of Hanson and Gayler, with modifications by Dix, Keller, and Willey.—S. G.

***Investigation of the β- and γ-Phases in the System Aluminium–Magnesium. (Contribution to the Problem of the Nature of Phases of Variable Composition.)** N. S. Kurnakow and V. I. Miheeva (*Izvestia Akademii Nauk S.S.S.R.* (*Bull. Acad. Sci. U.R.S.S.*), **1937**, [Chim.], (2), 259–287; German summary, 288).—[In Russian.] Curves are given showing the change in electrical resistance with zinc content at various temperatures for the β- and γ-phases of the system zinc–magnesium–aluminium. In the β-region the resistance isothermals are smooth curves, but in the γ-region the 20°, 100°, 200°, and 300° C. isothermals show a minimum, which is less sharp the higher is the temperature, and which disappears entirely at 400° C.; with increase in temperature, this minimum is displaced towards the magnesium side. The composition corresponding to the maximum approaches that of the compound Al_3Mg_4. The homogeneity limits of the β- and γ-phases in the ternary system were determined by micrographic examination; that of the β-phase is very narrow, whilst that of the γ-phase extends to 5·5% zinc, and, compared to its position in the binary magnesium–aluminium system, is further towards the magnesium side. The minima on the electrical resistance isothermals in the γ-region are displaced on the addition of zinc towards a higher magnesium content. Zinc, however, does not change the character of the isothermals of the β-phase. The nature of the β- and γ-phases is discussed, and it is suggested that these phases may be dissociated intermetallic compounds.—N. A.

***Effect of the Temperature of Age-Hardening on the Mechanical Properties of the Aluminium–Magnesium Alloys.** P. Lacombe (*Métaux et Corrosion*, 1937, 12, (143), 131–132).—The variations of the tensile strength and elongation of the Alumag alloys (solid solutions of aluminium and magnesium) with various times of ageing at 140°, 200°, and 300° C. were studied. At 300° C., the tensile strength continuously diminishes; at 200° C., it increases to a maximum and then decreases; at 140° C. it continuously increases. The 8% magnesium alloy after 500 hrs. at 140° C., has a maximum breaking load of about 50 kg./mm.^{2} and an elongation of about 14%. The 9·5% magnesium alloy has a lower maximum tensile strength (about 45 kg./mm.^{2}) after 50 hrs. The hardness of these alloys is unaltered, the phenomenon thus not resembling the ageing of Duralumin.—J. H. W.

Properties of Aluminium–Magnesium Alloys. L. W. Kempf and F. Keller (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 942–945).—Discusses the properties (illustrated by curves), casting and working characteristics, growth and corrosion-resistance of the binary alloys, with 8 references.—S. G.

***Age-Hardening and Properties of Magnesium–Aluminium Alloys.** D. A. Petrov (*Metallurg* (*Metallurgist*), 1937, (3), 95–103).—[In Russian.] See *Met. Abs.*, this vol., p. 493.—N. A.

Properties of Aluminium–Magnesium (4%) Casting Alloy. L. W. Kempf and H. J. Rowe (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 947).—The physical properties are given, with brief mention of the general properties and uses.—S. G.

Properties of Heat-Treated Aluminium–Magnesium (10%) Casting Alloy. L. W. Kempf and H. J. Rowe (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 946).—The physical properties of the heat-treated alloy are given, and the general properties and uses briefly mentioned.—S. G.

Aluminium–Magnesium–Chromium Alloy (52 S). F. Keller (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 956).—Deals briefly with the properties, workability, welding characteristics, forms, and uses of the alloy "52 S." A table gives typical mechanical properties for 5 tempers.—S. G.

†Constitution of Aluminium–Magnesium Silicide Alloys. E. H. Dix, Jr., F. Keller, and R. W. Graham (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 919–920).—A brief, critical review of the literature, with a *bibliography* of 4 references. A partial diagram of the system is given (Hanson and Gayler, with modified solubility curves by D., K., and G.).—S. G.

***The Ageing of Aluminium–Magnesium Silicide Alloys Containing Excess of Silicon (Avial and "51 S").** S. M. Voronov and I. A. Deutsch (*Aviopromishlennost* (*Aero. Ind.*), 1937, (5), 22–29; (6), 29–37).—[In Russian.] The maximum hardening is obtained by artificial ageing at 150° C. ± 5°; if this is done immediately after quenching, maximum hardness is obtained. Storage at room temperature after quenching decreases the effects obtained on subsequent ageing at 150° C. to an extent which reaches a maximum with a storage time of 6 hrs. The tensile strength, elasticity, and hardness are all decreased, but the elongation is increased. These effects can be avoided in 3 ways: (*a*) by increasing the ageing time to 18–24 hrs., which, however, decreases the elongation; (*b*) by subjecting the alloys to a short (10–20-minute) ageing at 150° C. immediately after quenching; they can then be stored indefinitely without losing their hardening capacity on ageing for 6–8 hrs. at 150° C.; (*c*) by addition of small amounts of copper and manganese, which produce an increase in strength and hardness without affecting the elongation; in this case the chromium can be omitted from the alloys. A theoretical explanation of the results is given.—N. A.

Properties of Wrought Aluminium–Magnesium–Silicon Alloys. F. Keller, C. M. Craighead, and T. W. Bossert (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 965–966).—The composition, properties, workability, welding characteristics, heat-treatment and ageing, applications, and forms are briefly dealt with. The mechanical properties of "53 S" for 6 tempers are tabulated.—S. G.

***Influence of Prolonged Heating on a Workable Magnesium–Silicon–Aluminium Alloy (Anticorodal).** A. von Zeerleder and E. von Burg (*Aluminium*, 1937, 19, (8), 502–503).—The mechanical properties of Anticorodal remain unchanged after heating for 2 years at 75° C., but at 130° C. the hardness, yield-point, and tensile strength slowly decrease while the elongation slowly increases. At 200° C. the alloy softens fairly rapidly but becomes dead soft only after 6 months, but at 300° C. this result is obtained in about 1 day. Curves are given showing the changes in mechanical properties produced by annealing for 1 hr., 1 day, 1 month, and 1 year at various temperatures up to 300° C., and the mechanical properties at various temperatures after keeping the alloy at these temperatures for various times. The tensile strength at 100° C. remains unchanged even after 18 months, but the strength at 250° C. decreases to a minimum of 5 kg./mm.^{2} after 3 months; the maximum permissible temperature at which the metal can be used is between 100° and 120° C. Only 30 minutes at 350°–400° C. is necessary to soften the alloy completely, so even short-time heating at these temperatures should be avoided.—A. R. P.

†**Constitution of Aluminium–Manganese Alloys.** E. H. Dix, Jr., W. L. Fink, and L. A. Willey (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 912–913).—A brief, critical review of the literature, with a *bibliography* of 6 references. The diagram of D., F., and W. (*Met. Abs.*, 1934, 1, 169) is reproduced.—S. G.

Wrought Aluminium–Manganese Alloy (3 S). P. V. Faragher (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 948).—The composition, properties, workability, welding characteristics, annealing, applications, and forms are briefly dealt with.—S. G.

Wrought Aluminium–Manganese–Magnesium Alloy (4 S). T. W. Bossert and J. A. Nock, Jr. (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 967).—Typical mechanical properties for 5 tempers are tabulated. Temper designations, workability, welding, heat-treatment, forms, and applications are briefly dealt with.—S. G.

†**Constitution of Aluminium–Nickel Alloys.** Wm. L. Fink and L. A. Willey (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 914).—A brief, critical review of the literature, with a *bibliography* of 5 references. The diagram of F. and W. (*Met. Abs.*, 1934, 1, 563) is reproduced.—S. G.

Aluminium–Nickel Alloys. —— (*Metallwirtschaft*, 1937, 16, (40), 1010–1015).—The properties and uses of some nickel-bearing aluminium alloys, especially R.R. alloys, are described.—v. G.

†**Constitution of Aluminium–Silicon Alloys.** E. H. Dix, Jr., and A. C. Heath, Jr. (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 915–916).—A brief, critical review of the literature, with a *bibliography* of 4 references. Diagrams of the aluminium end of the system are given. One shows the location of the eutectic by Edwards and liquidus curves by Gwyer and Phillips, the other is that of Dix and Heath (in the range 0—2·5% silicon).—S. G.

***Chemical Properties of Metallic Compounds. III.—Chemical Properties of Aluminium–Silicon Alloys and the Nature of the Eutectics.** J. A. Kliachko (*Zhurnal Obshey Khimii* (*J. General Chem.*), 1937, 7, (2), 492–498).—[In Russian.] Solution of silicon in aluminium alloys obeys the law of mass action, which is considered to be evidence in favour of the chemical nature of this process. The equilibrium constant of the reaction is the ratio between the silicon content of the saturated solid solution at the diffusing temperature and the silicon content of the eutectic. It is suggested that this rule is of general validity for all systems in which there is a range of limited solubility. The mechanism of eutectic crystallization is discussed, and the theory is advanced that at the eutectic point a dynamic–chemical equilibrium is reached.—N. A.

Properties of Aluminium–Silicon Alloys. L. W. Kempf (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 949–952).—Deals with the density, thermal expansion, electrical resistance, thermal conductivity, elastic properties, shear-strength, fatigue, impact properties, growth, solidification shrinkage, pattern shrinkage, and casting properties.—S. G.

Properties of Aluminium–Silicon (5%) Casting Alloys (43 or S.A.E. 35). H. J. Rowe (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 955).—The physical properties are given, and specifications and general properties and uses briefly dealt with.—S. G.

Properties of Aluminium–Silicon (13%) Casting Alloys. H. J. Rowe (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 953–954).—The physical properties are given, and specifications and general properties and uses briefly dealt with.—S. G.

***Constitution of the [Ternary] Aluminium Alloys with Silicon and Iron.** G. G. Urasov and A. V. Shashin (*Metallurg* (*Metallurgist*), **1937**, (4), 27–41).—[In Russian.] The structure of cast alloys of aluminium with up to 68·35% iron agrees with that expected from the constitutional diagram of Ageew and Vher. The liquidus surface in the iron–silicon–aluminium ternary system consists of 10 parts, corresponding to the 10 phases of the system. The ternary aluminium-rich solid solutions, $FeAl_3$, θ- and ε-phases, and the ternary iron-rich solid solutions, FeSi, $FeSi_2$, and Si, are analogous to these phases in the binary systems. In addition, the ternary system contains 2 phases, β and γ, which appear to be complex, with a variable content of all three metals. The boundaries of the fields corresponding to these phases have not yet been established.—N. A.

Properties of Heat-Treated Aluminium–Silicon–Copper–Magnesium Casting Alloys. L. W. Kempf and H. J. Rowe (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 968–969).—The general properties and uses are discussed, and the properties of heat-treated (silicon 5, copper 1·25, magnesium 0·5%) alloys are tabulated for 5 heat-treatments.—S. G.

Aluminium–Silicon–Magnesium Wrought Alloy (51 S). L. W. Kempf and J. H. Alden (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 974–975).—Typical mechanical properties for 3 tempers, and the physical properties of the wrought alloy are tabulated. Properties, workability, welding, heat-treatment and ageing, annealing, and forms are briefly dealt with.—S. G.

Properties of Heat-Treated Aluminium–Silicon–Magnesium Casting Alloy. L. W. Kempf and H. J. Rowe (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 970–971).—The physical properties of the heat-treated casting alloy containing silicon 7 and magnesium 0·3% are tabulated for 2 heat-treatments. The general properties and uses are briefly indicated.—S. G.

***Influence of Modification in Alloys of the γ-Silumin Type.** V. O. Gagen-Torn and M. M. Nazarova (*Legkie Metally* (*Light Metals*), **1937**, (5/6), 9–12).—[In Russian.] The structure and mechanical properties of γ-Silumin (silicon 12, manganese 0·3–0·4, magnesium 0·2–0·3%) after various heat-treatments have been investigated with and without a modification treatment (addition of sodium or melting under an alkali fluoride flux). The elongation of the modified alloy is somewhat greater than that of the non-modified alloy, but the other physical properties are at least as good or, in some cases, better. There is little difference in the two structures after quenching and reheating. The ordinary modification can therefore be omitted.—D. N. S.

Properties of Aluminium–Silicon–Nickel–Copper–Magnesium Alloy (132 and 32 S). L. W. Kempf and O. H. Heil (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 972–973).—The general properties and uses are briefly discussed, and the properties are tabulated for 3 heat-treatments. Curves show the tensile properties of chill-cast " 132 " alloy at elevated temperatures, and hardness at room temperature after stabilization and testing at elevated temperatures. —S. G.

†Constitution of Aluminium–Titanium Alloys. W. L. Fink and K. R. Van Horn (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 917–918).—A brief, critical review of the literature, with a *bibliography* of 6 references. A diagram is given, based on the work of various investigators.—S. G.

Properties of Aluminium–Zinc Alloys. L. W. Kempf (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 976–977).—Curves show the tensile properties of chill-cast alloys, and the effect of zinc on the tensile properties of aluminium (forged bars). The properties are briefly discussed, with 6 *references*.—S. G.

***On the Structure of Aluminium–Zinc Alloys.** W. Broniewski, J. Kucharski, and W. Winawer (*Rev. Mét.*, **1937**, **34**, (8), 449–461).—Thermal analyses on heating and during slow and rapid cooling, and microscopic examinations and resistivity determinations were carried out, special attention being paid to the β-phase. Diagrams of stable and labile equilibrium are deduced, the latter being without a transition line at 445° C. and having a labile eutectic at 345° C. containing 7% aluminium. The β-phase consists of solid solutions of zinc and aluminium in the compound Al_2Zn_3 partially dissociated into a pseudo-binary alloy.—H. S.

***Aluminium Alloy 24 S with Increased Strength, and Its Properties as Compared with Those of the M 95 and VV Alloys.** S. M. Voronov, M. I. Kovarsky, and L. G. Roshkovsky (*Aviopromishlennost* (*Aero. Ind.*), **1937**, (2), 29–38).—[In Russian.] A study was made of the influence of copper, magnesium, and manganese on the mechanical properties of aluminium-clad 24 S alloy (4% cladding on each side). As compared with M 95 and VV alloys, 24 S has a wider range of quenching temperatures. To obtain a minimum tensile strength of 42 kg./mm.^{2} in the quenched state, 24 S should contain copper 4–4·6, magnesium 1·3–1·7, manganese 0·4–0·8, iron $<$ 0·5–0·6, and silicon $<$ 0·5–0·6%. The best quenching range is 500°–510° C.—N. A.

Investigation of the American Alloy 25 S for Forging and Stamping of Aircraft Parts. S. M. Voronov and E. S. Babushkina (*Aviopromishlennost* (*Aero. Ind.*), **1937**, (3), 43–48).—[In Russian.] 25 S has excellent mechanical properties, especially after quenching and artificial ageing. The high elongation is due to the absence of magnesium. Heat-treatment consists in quenching from 520° C. ± 5°, and ageing at 150° C. ± 5° for 12–15 hrs. The alloy has a tendency to zonal segregation, and is less resistant to corrosion than Duralumin.—N. A.

***Modulus of Elasticity of Light Alloys for Aircraft.** Masaru Yano (*Mitsubishi Jukogyo K.K., Nagoya Kokuki Seisakujo Kenkyu Hokoku* (*Res. Rep. Nagoya Aircraft Plant, Mitsubishi Heavy Industries, Ltd.*), 1936, (**529**), 609–617).—[In Japanese.] Experiments were carried out on 28 specimens, including 12% copper–aluminium, Silumin, Lautal, No. 12 alloy, R.R. 50, Silumin-Gamma, Y-alloy, Duralumin, Super-Duralumin, Elektron, &c.—S. G.

***Fall-Hardness Tests on Workable Aluminium Alloys.** Paul Brenner and Hans Kostron (*Z. Metallkunde*, 1937, **29**, (9), 293–296).—Measurements were made of the hardness of various standard aluminium alloys at temperatures up to 450° C. by means of a 10-mm. ball falling 500 mm. under a 250-grm. load; the results are shown graphically. At temperatures up to 270° C., hardened alloys containing copper, nickel and copper, or magnesium and copper have the greatest hardness (*i.e.* resistance to indentation by a blow), but above this temperature plain magnesium–aluminium alloys are superior, since the other alloys lose their age-hardness; the hardness of this group increases linearly with increase in magnesium content.—A. R. P.

Recent Progress in the Development of Aluminium Alloys for Rolling. P. Brenner (*Jahrb. Lilienthal-Ges. Luftfahrt.*, **1936**, 431–458).—Methods of increasing the homogeneity of light alloys prior to rolling include the Züllin casting process, a description of which is given, and improved mechanical treatment of the ingot, the advantages of which are illustrated by tabulated summaries of forging tests. Recovery of the material from the Bauschinger effect may be accelerated by suitable storage conditions. Recently-developed materials include alloys of the Duralumin class with increased copper or silicon content, and plated and anodically-protected metal. The selection of plated materials for maximum strength or maximum durability is discussed, and the corrosion-resistance of plated and non-plated aluminium–copper–magnesium alloys is compared. A review is given of the results of recent tests on plated aluminium–magnesium alloys, with special reference to the diffusion of magnesium into the protective coating.—P. R.

On the Corrosion-Fatigue of Light Alloys. Kurt Matthaes (*Jahrb. Lilienthal-Ges. Luftfahrt.*, **1936**, 404–430).—A description is given of corrosion-fatigue tests in different media on a variety of light alloys. Under the conditions of test, certain magnesium-base casting and forging alloys, and some copper-free aluminium alloys of limited magnesium content, were almost unaffected by corrosion-fatigue. The behaviour of the Duralumin alloys depended chiefly on the concentration of the medium.—P. R.

The Hardening Capacity of Aluminium Alloys. H. Hornauer (*Werkstatt u. Betrieb*, 1937, 70, (19/20), 256–258).—A brief account is given of hardening phenomena, illustrated by references to the aluminium–copper series, and to a diagram showing the effect of storage in the tempered and untempered conditions on a quenched Duralumin alloy. The types of light alloy usually hardened are enumerated, and practical directions are given for heating, quenching, and annealing.—P. R.

***Surface-Hardening of Aluminium and Its Alloys.—I. [Rubinite Process.]** Kenzo Inamura and Kiyoichi Kodama (*Sumitomo Kinzoku Kōgyō Kenkyu Hōkoku* (*Res. Rep. Sumitomo Metal Ind., Ltd.*), 1937, 2, (11), 1237–1245).—[In Japanese.] Various methods for the formation of a very hard film on aluminium and its alloys by electrolysis were studied, and a new process—termed Rubynite—was invented. The hardness and abrasion-resistance of the film are very high.—S. G.

Aluminium Alloys as Bearing Metals. C. Steiner (*Jahrb. Lilienthal-Ges. Luftfahrt.*, 1936, 356–371).—The lubrication requirements of light alloys having eutectic, hyper- and hypo-eutectic structures are considered in relation to bearing design. The coeffs. of friction of 4 light alloys of the "KS" type, Delta metal, lead–bronze, and some special bronzes are compared graphically for various speeds, and also for a standard speed under different loads. Load–friction–speed diagrams are reproduced for 3 light alloys. Bearing temperatures, necessary clearance, wear, contamination of lubricants, and running-in conditions are discussed; the use of oil-grooves is shown to be advantageous. Summarized accounts are given of running tests on light alloy bearings in vehicle and aircraft engines.—P. R.

†On the Rubbing Properties of Light Metal Bearing Alloys with Especial Reference to Quarzal. M. von Schwarz (*Metallwirtschaft*, 1937, 16, (31), 771–776).—Running tests made on Quarzal (an aluminium alloy with a high copper content, together with other unstated constituents, the nature of which depends on the use to which the metal is to be put) gave satisfactory results on hard steel, grey cast iron, and heat-treated steels.—v. G.

Modern Problems of Light Metal Alloys. Erich Schmid (*Z. Metallkunde*, 1937, 29, (9), 281–286).—Modern work on the production of high-purity aluminium, the use of the metal for optical reflectors, the mechanism of age-hardening, and the development of twinning during deformation is reviewed.
—A. R. P.

†Manufacture and Characteristics of Hiduminium R.R. Alloys. J. Towns Robinson (*Metallurgia*, 1937, 16, (96), 201–204).—Important aspects of foundry technique are discussed, and R. stresses the need for co-operation between the designer and metallurgist, so that the application of each casting can be carefully studied and advantages taken of the special characteristics of a particular alloy. The manufacture of castings, with special reference to their soundness, is discussed, and consideration is given to methods of running and feeding, the uses and control of suitable sand, and the type of melting-furnace and type of crucible used. The properties and suitable applications of the R.R. casting alloys are also briefly referred to.—J. W. D.

Hiduminium R.R. 77. —— (*Metallurgia*, 1937, 17, (97), 22).—The general mechanical and physical properties of this alloy are given. It was developed for use in highly-stressed parts and has a high strength and good corrosion-resistance, fatigue-resistance, and electrical and thermal conductivity.—J. D.

***The System Iron–Beryllium.** I. S. Gaev and R. S. Sokolov (*Metallurg* (*Metallurgist*), 1937, (4), 42–48).—[In Russian.] The system has been studied up to 16% beryllium. The γ-iron field does not extend beyond 0·3–0·4% beryllium, and the solubility of beryllium in α-iron is 4·5–5·0% at 20° C. and 7·5–8% at 1150° C. A eutectic is formed between α and the hexagonal compound $FeBe_2$ at 10% beryllium at 1150° C. The lattice constant of α-iron decreases with an increasing beryllium concentration. With > 0·5% beryllium, the alloys become increasingly brittle. Experiments are described on the rate of diffusion of beryllium into iron, and on the nitrogenation of the alloys.—N. A.

***[Contribution] to Our Knowledge of the Mechanism of Solidification of Antimony–Bismuth Alloys.** Willi Claus (*Z. Metallkunde*, 1937, **29**, (8), 268–270).—Alloys of 65–85% bismuth with 35–15% antimony have no tendency to inverse segregation, and are quite free from porosity, whether cast in chill or sand moulds.—A. R. P.

The More Complex Fusible Metals. Properties of the Indium–Gallium Alloys. S. J. French (*Sci. Monthly*, 1936, (Sept.); and (condensed) *Met. Ind.* (*Lond.*), 1937, **50**, (10), 298).—The scanty knowledge available of the tin–lead–bismuth–cadmium alloys is reviewed, and the effects of adding indium, gallium, and thallium are described. The addition of 6% thallium gives an alloy melting at 66° C., and 18% indium gives a melting point of 46·7° C. The addition of 1% thallium to the complex indium alloy decreases the melting point to 41·5° C. Possible applications of these alloys in surgery are suggested.—H. W. G. H.

***Properties of Alloys of Cadmium and Mercury with Small Percentages of Nickel.** Telfer E. Norman and Owen W. Ellis (*Metals Technology*, 1937, **4**, (7); *A.I.M.M.E. Tech. Publ.* No. 850, 4 pp.).—Cadmium–mercury–nickel alloys were prepared containing 1% nickel, and from 0 to 40% mercury. Tensile, compression, and Brinell hardness tests were carried out on chill-castings. The mechanical properties of the alloys containing mercury are inferior to those of the plain nickel–cadmium alloy, the effect becoming more marked with increasing mercury content, but most of the ternary alloys are superior to the commoner tin-base bearing metals. The solidus line was determined for alloys containing 1% nickel and 0–40% mercury.—W. H.-R.

Constitution of the Cadmium–Nickel Alloys. Carl E. Swartz (*Metals Handbook* (*Amer. Soc. Metals*), 1936, 1012).—The diagram of Voss, up to 8% nickel, as modified by the results of Swartz and Phillips (*Met. Abs.* (*J. Inst. Metals*), 1933, **53**, 696) is reproduced.—S. G.

Properties of the Cadmium–Nickel Alloys (with Special Reference to Their Use as Bearing Liners). Carl E. Swartz (*Metals Handbook* (*Amer. Soc. Metals*), 1936, 1013–1014).—Discusses the structure, bonding, and physical properties. A table gives the fatigue strength, solidification range, and coeff. of linear expansion, and also the tensile properties and hardness at various temperatures, of the 1·3 and 3% nickel alloys. Stress–strain relationships in compression are shown by curves.—S. G.

***Changes in the Electrical Resistance of Iron–Chromium–Aluminium Heating Elements for Temperatures up to 1300° C.** Erich Schoene (*Elektrowärme*, 1937, **7**, (10), 220–226).—Life experiments on 7 commercial heating elements of the aluminium–chromium–iron type are recorded. As received, 5 of these gave a mean temperature coeff. of resistance (α) between 20° and 1300° C. of $1\cdot3$–$4\cdot1 \times 10^{-5}$, and the others α values of $15\cdot5$ and $31\cdot2 \times 10^{-5}$. In all cases the hot-resistance increased and the cold-resistance slightly decreased during prolonged use; in 4 cases the resistance–temperature curve became continuously steeper between 300° and 700° C. owing to precipitation of a magnetic phase, and the consequent structural changes. Life is decreased by constant running at a very high temperature, and also by the frequent switching on and off of the current at high temperatures, owing to the resulting flaking-off of the protective oxide film. During use the α increases at first slowly, and then more rapidly, until it eventually reaches 10–12 times its original value. These changes are ascribed to the following sequence of events: recovery and recrystallization of the wire, reduction of the aluminium content by surface oxidation, oxidation of the chromium and aluminium to form a resistant scale, and slow penetration of this oxide into the grain boundaries.—A. R. P.

***X-Ray Study of Effects of Adding Carbon, Nickel, or Manganese to Some Ternary Iron–Chromium–Silicon Alloys.** Eric R. Jette and A. G. H. Andersen (*Metals Technology*, 1937, **4**, (7); *A.I.M.M.E. Tech. Publ.* No. 852, 15 pp.).—(*a*) The effect of adding carbon to ternary iron–chromium–silicon alloys was studied by the X-ray crystal analysis of specimens after different heat-treatments. The solubility of carbon in the α-phase is very low, and probably in the vicinity of 0·02 to 0·04%. The effect of larger carbon contents is to diminish the parameter of the α-phase; the graph connecting the lattice spacing and the percentage of carbon shows a discontinuity between 0·35 and 0·5% carbon, the position of the discontinuity depending on the gross alloy composition. For carbon contents greater than the point of discontinuity, the carbide phase has trigonal symmetry, and is based on a compound of formula Cr_7C_3, in which some chromium may be replaced by iron. In alloys containing from 2 to 4% carbon, this carbide is found when the gross ratio of percentage of chromium to percentage of iron lies between 0·15 and 0·42. When the gross chromium : iron ratio is between 0·4 and 3·1, a carbide based on the compound $Cr_{23}C_6$ is present, and may contain as much as 35% iron by replacement of chromium. No evidence was found for the existence of γ-iron in iron–chromium–silicon–carbon alloys. (*b*) Preliminary data on the effect of addition of nickel or manganese to iron–chromium–silicon alloys are described.—W. H.-R.

***Notes on the Microstructure and Hardness of Alloys Consisting Essentially of Iron, Chromium, and Silicon.** A. G. H. Andersen and Eric R. Jette (*Metals Technology*, 1937, **4**, (7); *A.I.M.M.E. Tech. Publ.* No. 853, 8 pp.): (cf. preceding abstract).—The microstructures of a few iron–chromium–silicon alloys are illustrated and described, and results are given of hardness tests on these alloys after different heat-treatments, and also for alloys containing carbon, nickel, or manganese. The alloys of higher chromium content, containing more than about 3% silicon, are brittle and have low tensile strength and small ductility.—W. H.-R.

***Investigations on Cobalt and the System Cobalt–Carbon.** Wilhelm Fr. Meyer (*Z. Krist.*, 1937, **97**, (3), 145–169).—[In German.] Previous work on the crystal structure of cobalt and the transformation from the close-packed hexagonal to the face-centred cubic structure is reviewed. The transformation is studied by means of Debye–Scherrer X-ray photographs, and the effect of compressing the metal is investigated. Photographs in a high-temperature camera show that a second transformation does not occur at high temperatures, the cubic form alone being found up to 1100° C. The action of coal-gas on cobalt at different temperatures is studied, and carbon monoxide is shown to be the active constituent. At 230°–270° C. solid solutions of different compositions are formed, but are not stable at room temperature. In the range 500°–800° C. a stable carbide Co_3C is formed with a crystal structure similar to that of Fe_3C; the lattice constants of Co_3C are $a = 4{\cdot}52$ A., $b = 5{\cdot}08$ A., $c = 6{\cdot}73$ A. The action on cobalt of a mixture of hydrogen and benzene vapour was studied up to 1200° C. The results are complex and conflicting, but the final results described in a supplement indicate that Co_3C is formed in approximately the same temperature range as in the reaction with carbon monoxide; at higher temperatures, coke-like masses are obtained containing graphite and cobalt.—W. H.-R.

†Constitution of Copper–Aluminium Alloys. G. F. Comstock (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1026–1027).—A critical review of the literature, with a *bibliography* of 10 references. The diagram of Stockdale (*J. Inst. Metals*, 1922, **28**, 273), up to 18% aluminium, is reproduced.—S. G.

***A New Intermediate Phase in the Aluminium–Copper System.** A. G. Dowson (*J. Inst. Metals*, 1937, 61, 197–204).—This work was originally undertaken to fix more accurately the position of the boundaries between the β- and γ-phases in the aluminium–copper system at high temperatures. A series of alloys containing between 12·5 and 18% aluminium by weight was examined above 900° C. by thermal, micrographic, and dilatometric methods. A new stable phase between 14 and 17% aluminium has been shown to exist above 963° C., at which temperature it decomposes into a eutectoid mixture of β and γ. The eutectoid composition is 15·4% aluminium by weight. The new phase, like β of high aluminium content, cannot be retained by quenching, and it is impossible, therefore, to distinguish the two under the microscope. Both appear half-tone with the γ white.—A. G. D.

***The Equilibrium Diagram Aluminium–Copper.** Arthur Gordon Dowson (*Abstracts Dissertations Univ. Cambridge,* **1936–1937**, 116).—See preceding abstract.—A. G. D.

***Copper-Rich Nickel–Aluminium–Copper Alloys. I.—The Effect of Heat-Treatment on Hardness and Electrical Resistivity.** W. O. Alexander and D. Hanson (*J. Inst. Metals*, 1937, 61, 83–99; discussion, 99–102).—Some 56 copper alloys, containing quantities of nickel and aluminium varying up to 10% by weight of each metal, were cast and extruded. The effect of heat-treatment on the hardness and electrical resistivity of these alloys was observed. The results indicate that above 800° C. all the alloys consist of uniform α solid solution. When heated at temperatures below 800° C. some of the alloys harden, and their electrical resistivity decreases. The results reveal the approximate limits of the α solid solution, whilst the manner of the changes in properties at lower temperatures implies precipitation of new phases, the origin of one lying in the direction of the nickel–aluminium binary system.—W. O. A.

†Constitution of the Copper–Beryllium Alloys. H. C. Jennison and H. F. Silliman (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1028–1029).—A brief, critical review of the literature, with a *bibliography* of 9 references. A diagram is given, based on the work of various investigators.—S. G.

***Influence of Iron on the Properties of Copper–Beryllium Alloys.** I. A. Amsterdamski (*Metallurg* (*Metallurgist*), **1937**, (4), 122–130).—[In Russian.] Even as little as 0·12–0·15% iron in 2% beryllium–copper alloys causes the appearance of a new phase and a considerable grain-refinement in quenched alloys. The new phase appears to consist of an iron-rich compound of beryllium containing copper either in solid solution or in chemical combination; the quantity present in any alloy increases considerably with increase of temperature. This phase has a Brinell hardness of 80–100, and readily deforms on cold-working. The grain-refinement produced by the presence of this phase improves the mechanical properties of the alloy, but for a given beryllium content the mechanical strength of the alloy is reduced, since the amount of beryllium in solid solution is decreased. The relative importance of these two effects determines the advisability of adding iron to the alloy. The best results are obtained by addition of only 0·12–0·15% iron. Alloys of this composition show an increased mechanical strength, both in the quenched and in the age-hardened states, combined with greater ductility and resistance to softening after a prolonged heating at 300° C., as compared with the iron-free alloy, which loses hardness after 10–14 hrs. at this temperature. Alloys with 0·7% iron have a tensile strength of 112–114 kg./mm.^{2}, with an elongation of 10–13% after ageing. Alloys with $>$ 1·5% iron are of no practical importance. —N. A.

***Studies on Beryllium-Containing Copper Alloys.** Kenzo Inamura and Hidekichi Ohashi (*Sumitomo Kinzoku Kōgyō Kenkyu Hōkoku* (*Res. Rep. Sumitomo Metal Ind., Ltd.*), 1937, 2, (11), 1211–1236).—[In Japanese.] The object of the investigation was to find better alloys than beryllium bronze containing 2–3% beryllium. In this paper are described the experimental results on beryllium–nickel–copper and chromium–beryllium–nickel–copper alloys. Among the alloys in the range nickel 2–10, beryllium 0·2–2%, it was found that the alloy containing nickel 2 and beryllium 0·5% has a very high tensile strength and a high electrical conductivity after suitable heat-treatment. To improve the properties of this alloy, the effects of iron or chromium were studied; finally, an excellent alloy, named Berychrome No. 1, was obtained. Its standard composition is nickel 2, beryllium 0·5, chromium 0·5, other elements $< 0·5\%$, remainder copper. The mechanical properties of this alloy are given (in English) in a table. The tensile strength and hardness are slightly less, but the elongation and electrical conductivity are higher, than for beryllium bronze.—S. G.

***Beryllium–Copper Wire has Unique Characteristics.** Jack Delmonte (*Wire and Wire Products*, 1936, **11**, (7), 326–327, 355).—Curves are given showing the influence of time of heat-treatment at various temperatures on the tensile strength of 2% beryllium–copper alloy; the effect of prolonged heat-treatment (at an unspecified temperature) in increasing the electrical conductivity of alloys containing beryllium up to 3·5%; and the effect of cold-work (by wire-drawing) in *increasing* the conductivity of heat-treated 2% beryllium–copper wires.—J. C. C.

†**Constitution of Copper–Cadmium Alloys.** Cyril Stanley Smith (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1030–1031).—A brief, critical review of the literature, with a *bibliography* of 7 references. The diagram of Jenkins and Hanson (*J. Inst. Metals*, 1924, **31**, 257) is reproduced, and the γ-field is also shown on a larger scale. The α-phase boundary according to Owen and Pickup (*Met. Abs.*, (*J. Inst. Metals*), 1933, **53**, 189) is also reproduced.—S. G.

***The Constitution of the Copper–Gallium Alloys in the Region 18 to 32 Per Cent. of Gallium.** William Hume-Rothery and Geoffrey Vincent Raynor (*J. Inst. Metals*, 1937, **61**, 205–222; discussion, 222).—The equilibrium diagram of the system copper–gallium was investigated above 420° C. in the region 18–32 atomic-% gallium. Three distinct modifications of the β-phase, denoted β, β', and β'', are shown to exist above 420° C., and there is evidence that a further modification exists at low temperatures. The β-phase, stable at high temperatures, has a considerable range of composition which diminishes rapidly with decreasing temperature until a eutectoid point is reached at 618° C. The phase boundaries for this modification of the β-phase agree well with the diagram of Weibke, but, in contrast to the results of Weibke, the eutectoid transformation is not a reaction of the type $\beta \rightleftharpoons \alpha + \gamma$, but $\beta \rightleftharpoons \beta' + \gamma$, where the β'-phase exists over a narrow range of composition in the region 22·3 atomic-% gallium. The β'-phase is stable above 475° C., at which temperature another transformation takes place with the formation of the β''-phase existing over a narrow range of composition in the region 21·5 atomic-% gallium.—W. H.-R.

Constitution of Copper–Lead Alloys. G. C. Holder (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1032).—A brief review of the literature, with a *bibliography* of 11 references. A diagram is given.—S. G.

Copper–Lead Bearing Metals. J. L. McCloud (*Metal Progress*, 1937, **32**, (3), 267–268).—The optimum distribution of lead in copper–lead bearing alloys should be secured by chilling, since the use of nickel may result in scoring of the shaft. The difficulty of preventing lead segregation has caused some manufacturers to use cadmium–silver or cadmium–nickel alloys in preference to lead bronzes. Reference is made to the harmful effect of phosphorus exceeding 0·10% in lead–bronze bearings.—P. R.

†**Constitution of Copper–Manganese Alloys.** Cyril Stanley Smith (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1033–1035).—A critical review of the literature, with a *bibliography* of 20 references. The diagram of Ishiwara (*J.

Inst. Metals, 1930, 43, 473, 474) is given, slightly modified, and the α-phase boundary suggested by Persson is also shown in this diagram by means of a dotted line. Persson's diagram of lattice parameters (*Z. physikal. Chem.*, 1932, [B], 9, 25) is reproduced.—S. G.

***On the Alloys of Copper with Manganese.** W. Broniewski and S. Jaślan (*Ann. Acad. Sci. Tech. Varsovie*, 1936, 3, 141–154).—A study was made of the alloys of electrolytic copper with commercial manganese (manganese 96·25, aluminium 1·20, silicon 0·55, iron 1·01, carbon 0·20, phosphorus 0·15, sulphur 0·64%) by the observation of heating and cooling curves, measurements of physical and mechanical properties, and micrographic examination. Exact details of the technique of thermal analysis or rates of heating and cooling are not given. The general form of the equilibrium diagram constructed on the basis of these results agrees with that of Ishiwara (*Met. Abs.* (*J. Inst. Metals*), 1931, 47, 268), but it differs entirely in detail, and a number of experimental points are unexplained. The maximum solubility of manganese in copper was found to be 49 weight-% at the 895° C. peritectic (γ + liq. $\rightleftharpoons \delta$). This peritectic was not observed by Ishiwara. The liquidus and solidus curves above the δ-solid solution of manganese in copper exhibit a minimum at 870° C. and 38% manganese. The γ-phase was found to dissociate below 825° C. into the δ-solid solution and β-manganese, giving a eutectoid point at 83% manganese. Measurements were made of electrical conductivity at 0° C., variation of electrical resistance with temperature, thermoelectric power and its variation with temperature, electrode potential, coeff. of expansion and its variation with temperature, and hardness for alloys annealed at 600° C. In the case of rolled and re-annealed alloys up to 30% manganese, the tensile strength, elastic limit, extension, constriction, and hardness were also measured.—P. W. R.

***On the Electrical Properties of Manganin After Various Heat-Treatments.** A. Schulze (*Metallwirtschaft*, 1937, 16, (38), 954–957).—The effect of heat-treatment on the temperature coeff. of electrical resistance of Manganin (copper 86, manganese 12, nickel 2%) was investigated. The lowest value is obtained when the wires are annealed in the final state for 1 hr. at 375°–400° C. in nitrogen or argon, and then allowed to cool slowly.—v. G.

Constitution of Copper–Nickel Alloys. N. B. Pilling and T. E. Kihlgren (*Metals Handbook* (*Amer. Soc. Metals*), 1936, 1036).—A brief review of the literature, with a *bibliography* of 7 references. The diagram of Guertler and Tammann (*Z. anorg. Chem.*, 1907, 52, 25) is reproduced.—S. G.

Properties of Cupro–Nickel. H. C. Jennison and W. S. Girvin (*Metals Handbook* (*Amer. Soc. Metals*), 1936, 1085–1086).—The physical properties of the 15, 20, and 30% nickel alloys are given, and diagrams show the effect of annealing and of rolling on the hardness and tensile properties. The average tensile properties at elevated temperatures are given.—S. G.

***On the Mechanical Properties of the Alloys of Copper with Nickel.** W. Broniewski and S. Kulesza (*Métaux et Corrosion*, 1937, 12, (140), 67–73; and *Metal Treatment*, 1937, 3, (11), 114–117).—A study was made of the mechanical properties of the copper–nickel alloys cast *in vacuo*, forged, rolled, and annealed. In the annealed condition, the alloys have a maximum tensile strength and Brinell hardness of 42 kg./mm.^{2} and 42, respectively, at about 60% nickel. The elongation to fracture has a maximum of 39% at about 40% nickel. The impact strength for the paramagnetic alloys is about 17 kg./cm.^{2}, and is a maximum of 27 kg./cm.^{2} at about 80% nickel for the ferromagnetic alloys. The 70% nickel alloy appears to have the best mechanical properties; Monel metal is slightly superior to this alloy. Cold-work increases the hardness more rapidly than the tensile strength; the proportional elongation tends to disappear. The maximum Brinell hardness of about 170 is attained with the alloys containing between 60 and 70% nickel, with 40% cold-work.—J. H. W.

†**Constitution of Copper–Nickel–Tin Alloys.** J. T. Eash (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1053–1055).—A critical review of the literature, with a *bibliography* of 9 references. Diagrams are given (up to 32% tin) for the copper–tin alloys (based on the work of Stockdale and of Bauer and Vollenbruck), and for the ternary alloys containing 2% nickel (Eash and Upthegrove), and 5 and 10% nickel (Veszelka, and Eash and Upthegrove). A ternary diagram shows the phases existing at 300° C., together with the α-phase boundary at 780° C.—S. G.

Properties of Copper–Nickel–Tin Alloy (Adnic). W. B. Price (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1102–1105).—The physical properties of Adnic (an alloy containing nominally copper 70, nickel 29, and tin 1%) are given. Curves show the effect of annealing on grain-size, hardness, and tensile properties of hot-worked strip, effect of cold-rolling on tensile properties and hardness of strip, effect of cold-drawing on the tensile properties of wire, short-time tensile properties of rod at elevated temperatures, and time-elongation at 400°, 600°, 800°, and 1000° F.—S. G.

†**The Constitution of the Copper–Nickel–Zinc Alloys.** T. E. Kihlgren (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1056–1058).—A critical review of the literature, with a *bibliography* of 12 references. The diagrams of liquidus temperatures due to Tafel, and the phase boundaries determined by Bauer and Hausen are reproduced. A suggested ternary diagram is given. —S. G.

Properties of Copper–Nickel–Zinc Alloys (Ambrac). H. C. Jennison and W. S. Girvin (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1106–1107).—The alloy Ambrac 850 has the composition copper 75, nickel 20, zinc 5%. Its physical properties, and the mechanical properties at room and elevated temperatures, are given, and its applications are indicated.—S. G.

Constitution of Copper–Phosphorus Alloys. E. W. Roath (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1037–1038).—A brief review of the literature, with a *bibliography* of 12 references. A diagram (up to 15% phosphorus) is given.—S. G.

†**Constitution of Copper–Silicon Alloys.** Cyril Stanley Smith (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1039–1041).—A critical review of the literature, with a *bibliography* of 16 references. The diagram given is that of Smith (*J. Inst. Metals*, 1928, **40**, 359, 509), save for the addition of the ε-phase at 10·5–10·7% silicon and the renaming of Smith's ε-phase as η. —S. G.

***A Copper–Silicon Alloy as a Substitute Material for Pure Copper in Water-Heating Apparatus.** Karl Kaiser (*Z. Metallkunde*, 1937, **29**, (8), 263–265).—Addition of silicon to copper increases the strength considerably, the best mechanical properties being obtained with about 3% silicon; this alloy, after annealing at 650° C., has a tensile strength of 37 kg./mm.^{2}, an elongation of 68%, and a Brinell hardness of 67. Replacement of 0·7–0·8% of the silicon with manganese has little effect on the mechanical properties, but considerably reduces the grain-size after annealing, and prevents formation of large twinned crystals. The 2·2 : 0·8 : 97 silicon–manganese–copper alloy has *d* 8·8, a thermal conductivity of 0·135 cal./° C./cm./second, an electrical conductivity of 6·08 m./ohm/mm.^{2} at 20° C., and a thermal coeff. of expansion of 18×10^{-6}; it can readily be hot-rolled at 800°–500° C., and then cold-rolled to any desired thickness of sheet. The sheet can be used to replace copper sheet 2–3 times as thick in the construction of hot-water apparatus, and has a high resistance to corrosion and to distortion.—A. R. P.

Properties of Silicon Bronze (Everdur). H. C. Jennison and W. R. Hibbard (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1108–1110).—The corrosion-resistance, workability, welding properties, annealing, and applications of these "bronzes" are briefly discussed, and the tensile properties at low, room, and elevated temperatures are given. Curves show the effect of annealing on hardness and tensile properties when rolled to 0·041 in. gauge. —S. G.

Properties of Copper–Silicon–Tin Bronze (Herculoy). E. E. Wachsmuth (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1111–1113).—The approximate basic composition of this alloy is copper 96·25, silicon 3–3·25, tin 0·5%; the individual constituents may be varied, or other elements added, if particular characteristics are required. The physical and mechanical properties are given, and recrystallization, annealing, machining, soldering and welding, fabricating properties, and corrosion-resistance briefly dealt with. Diagrams show ultimate tensile strength and yield-point *v.* % cold-reduction by drawing for relief-annealed and hard-drawn rod; effect of annealing on physical properties of sheet after various reductions; and temperature–tensile strength curves of rod.—S. G.

†Constitution of Copper–Silver Alloys. Cyril Stanley Smith (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1042–1045).—A critical review of the literature, with a *bibliography* of 33 references. The complete constitutional diagram and diagrams for the silver- and copper-rich alloys, based on the work of various investigators, and also diagrams of the lattice parameters of the silver- and copper-rich alloys, are given.—S. G.

***Some Alloys of Copper [with Tantalum and with Vanadium].** Arthur Gordon Dowson (*Abstracts Dissertations Univ. Cambridge*, **1936–1937**, 116).—A brief abstract. The probable forms of the equilibrium diagrams at the copper-rich ends have been determined. The solubility of the alloying element is very small in each case. The mechanical properties of the tantalum alloys are not superior to those of copper; the alloys with vanadium show the better hardness values, and are capable of age-hardening.—A. G. D.

†Constitution of Copper–Tin Alloys. Samuel L. Hoyt (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1046–1048).—A critical review of the literature, with a very brief *bibliography* of 9 references. A diagram is given, which is essentially that of Heycock and Neville.—S. G.

***Inverse Segregation and the "Tin Sweat" of Bronzes.** G. Somigli (*Bull. Assoc. Tech. Fonderie*, 1937, **11**, (6), 234–236).—Summary from *Industria meccannica*, 1936, **18**, 347–355, 424–434; see *Met. Abs.*, 1936, **3**, 511.—S. G.

Copper Alloys as Bearing Materials. D. P. C. Neave and W. B. Sallitt (*Inst. Mech. Eng. General Discuss. on Lubricants, Advance Copy*, **1937**, (Group I), 190–197; and *Met. Ind.* (*Lond.*), 1937, **51**, (16), 377–380).—It is stated that the success of bronzes as bearing materials is due to: (1) fair retention of strength, (2) low rate of oxidation, (3) good thermal conductivity, and (4) certain little-known high-temperature surface characteristics of bronzes in contact with steels. The following types of copper-tin bearing materials are considered: α-bronzes (these are not considered to be good bearing materials); α–δ duplex bronzes; gun-metals; lead-bronzes, including leaded α-tin bronzes and copper-lead alloys with a small percentage of tin. Reference is made to powder-moulded copper–tin bearings consisting of 90% copper powder and 10% tin powder, with and without graphite. Ease of production and safety of operation without lubricant are the advantages claimed for these bearings. Brief comments are made on fabrication and bearing properties of brass, manganese–bronze, aluminium–bronze, silicon–bronzes, and beryllium–bronze. The expensive beryllium–bronze is used in the precipitation-hardened condition. A table is given of the nominal compositions, structures, approximate average mechanical properties of sand-cast bars, approximate standard specification, and descriptions and applications of some typical bearing bronzes.—R. Gr.

Copper–Lead–Tin Alloy (Cu 80, Pb 10, Sn 10%). G. H. Clamer (*Metals Handbook* (*Amer. Soc. Metals*), 1936, 1087–1088).—Briefly discusses the structure, A.S.T.M. specification for composition, effect of major constituents, and impurities, and gives the physical properties of sand-castings.—S. G.

Properties of Bronze (88 : 10 : 2 and 88 : 8 : 4). Lewis H. Fawcett (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1089–1093).—Discusses the effects of major and minor constituents, physical and mechanical properties, specifications, melting and moulding, and test-bars. A *bibliography* of 25 references is given.—S. G.

Segregation Phenomena in Lead–Bronzes. W. Claus (*Found. Trade J.*, 1937, **57**, (1106), 343, 346).—See *Met. Abs.*, this vol., p. 496.—S. G.

The Cast [Copper–Lead–Tin–Zinc] Alloy 85 : 5 : 5 : 5. J. W. Bolton, F. L. Wolf, and Wm. Romanoff (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1096–1097).—Deals with the A.S.T.M. specification, impurities, and physical properties.—S. G.

***A Bronze with 2·7 Per Cent. Nickel as a Bearing Alloy.** N. N. Serafimovich (*Metallurg* (*Metallurgist*), **1937**, (4), 131–133).—[In Russian.] The bearing properties of a bronze containing copper 85–86, tin 11–12, phosphorus 0·1–0·2, and nickel 2–2·7% were studied by the method previously described (*ibid.*, **1936**, (6), 102). The bronze surface is first smoothed by contact with rolls running at a speed of 0·8 m./second, under a load of 10–11 kg./mm.^{2}. On subsequent testing in conjunction with a roll of case-hardened steel, under a load of 800 kg./cm.^{2} at a speed of 0·8 m./second, the bronze showed a loss in weight of only 0·4 mg. in 5 hrs., equivalent to 0·026 mg./km.—N. A.

The Properties of Some Typical Cast Low-Nickel Bronzes. —— (*Nickel Bull.*, 1937, **10**, (8/9), 177).—The mechanical properties of 8 alloys are tabulated, and typical applications of each alloy are briefly indicated.—S. G.

Properties of Wrought Phosphor–Bronze. H. C. Jennison and W. S. Girvin (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1098–1101).—Tables give the physical properties, temper requirements for 3 grades of sheet, and the A.S.T.M. requirements as to chemical composition. Curves show the effect of annealing on the hardness and tensile properties of sheet, and the Rockwell hardness, tensile strength, and density of annealed and cold-rolled sheet (0 to 11% tin).—S. G.

***On Phosphor–Bronze Piston Rings.** Sokichi Kawaguchi (*Imono* (*J. Casting Inst. Japan*), 1937, **9**, (3), 148–158).—[In Japanese.] A study of piston rings for by-pass valves of locomotives. The specimens were of phosphor-bronze of 3 qualities, containing 11, 15, and 20% tin, respectively, with and without an addition of 3% nickel.—S. G.

†**High-Duty Brasses and Bronzes Available to the Engineer.** F. Hudson (*Metallurgia*, 1937, **16**, (96), 195–198; **19**, (97), 13–16).—The mechanical properties, treatment, and some typical applications of some high-duty alloys (α- or $\alpha + \beta$-range of compositions) are discussed under the grouping of high-duty brasses, and include aluminium–bronze, manganese–brass, copper–nickel–aluminium alloys, silicon–manganese–copper alloys, and beryllium–copper. It is suggested that the future development of these high-duty brasses will centre round those alloys capable of being heat-treated. The true bronzes—alloys containing an appreciable quantity of tin—including Admiralty gun-metal, low- and high-nickel bronzes, bearing bronzes, and phosphor–bronze, are also discussed.—J. W. D.

†**The Constitution of the Copper–Zinc Alloys.** Arthur Phillips and Austen J. Smith (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1049–1052).—A critical review of the literature, with a *bibliography* of 33 references. A diagram is given, based on the work of numerous investigators. Tables give the con-

centration limits and temperatures of peritectic horizontals, concentration limits at 400° C., and X-ray data.—S. G.

***Investigation of the Diagram of Composition–Mechanical Properties in the System Copper–Zinc.** S. I. Gubkin and P. A. Zaharov (*Izvestia Akademii Nauk S.S.S.R.* (*Bull. Acad. Sci. U.R.S.S.*), **1937**, [Chim.], (1), 41–65; German summary, 65–69).—[In Russian.] The mechanical properties of 19 copper–zinc alloys were studied at various temperatures. A relatively sharp increase in hardness and in the pressure required for extrusion occurs with alloys containing 9–12% zinc, at > 450° C. Between 20° and 450° C. two temperature ranges have been observed in which copper becomes less plastic and its viscosity increases.—N. A.

***The Transformation in the β-Brasses.** C. Sykes and H. Wilkinson (*J. Inst. Metals*, 1937, **61**, 223–239; discussion, 240).—The energy released during the β–β′ transformation in brass has been determined as a function of both temperature and composition. The results are compared with those predicted by the theoretical work of Bragg and Williams and of Bethe.—C. S.

***Solubility of Copper in the Grain-Boundary Material of a Solid Solution of Copper in Zinc.** George R. Dean and Wheeler P. Davey (*Amer. Soc. Metals Preprint*, **1937**, (Oct.), 10 pp.).—The concentration of copper in the body of crystals of the ε-solid solution of copper in zinc exceeds that in the grain-boundary material by 0·1–0·4%. Specimens from appropriate regions, exposed by cuts in bakelite lacquer films on etched surfaces of annealed alloys, were removed by electrolytic etching in a sodium acetate–acetic acid solution, plated on to a platinum cathode, dissolved in acid, and analyzed spectrographically. The results are discussed in the light of the Gibbs isotherm.—G. V. R.

***Temperature Dependence of Diamagnetism in Gamma-Brasses.** C. T. Lane (*J. Applied Physics*, 1937, **8**, (10), 693–699).—A series of measurements was made on the temperature-dependence (20°–700° C.) of the magnetic susceptibility of several γ-brasses. At room temperature the susceptibility is a linear function of composition, in agreement with previous work. At higher temperatures, however, this linearity no longer holds, the departure being greater at the higher temperatures. At the copper-rich end of the phase, the susceptibility increases with temperature, while the reverse is true at the zinc-rich end, and the susceptibility is sensibly constant near the theoretical composition Cu_5Zn_8. The bearing of these results on the Bloch theory of metals is discussed.—S. G.

Medium Red Brass Cast Alloys. H. M. St. John (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1094–1095).—Briefly deals with uses, composition and physical properties, machining qualities, properties at elevated temperatures, corrosion-resistance, effect of alloying elements, and impurities.—S. G.

***The Mechanical Properties of the Copper–Zinc Alloys.** W. Broniewski and S. Trzebski (*Prace Zakładu Metalurgicznego Politechniki Warsawskiej*, 1934, **4**, 3–16).—[In Polish, with French summary.] See *Met. Abs.*, 1934, **1**, 416. —S. G.

***Influence of Temperature on the Mechanical Properties of Brasses.** W. Broniewski and K. Wesołowski (*Prace Zakładu Metalurgicznego Politechniki Warsawskiej*, 1934, **4**, 46–70).—[In Polish, with French summary.] See *Met. Abs.*, 1934, **1**, 70.—S. G.

Properties of Wrought 66 : 34 Brass. R. S. Pratt (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1078–1084).—Discusses the general properties, mechanical properties, annealing, effect of cold-work, effect of impurities, corrosion, specifications and tests, and use. Diagrams show the effect of cold-drawing on physical properties, comparative hardness data, comparative test data used in controlling annealed high brass, and approximate bending characteristics of sheet. A *bibliography* of 26 references is appended.—S. G.

67 : 33 Brass Sheet : Ratio of Hardness to Tensile Properties. L. Loskiewicz (*Metal Progress*, 1937, 32, (3), 272).—The relation between ultimate tensile strength, reduction of area, and Brinell hardness in 67 : 33 brass sheet subjected to various degrees of cold-rolling is shown diagrammatically, and formulæ connecting Brinell hardness and tensile strength, and minimum elongation and tensile strength, are based on the experimental data so summarized.—P. R.

Properties of Commercial Brasses. D. K. Crampton (*Metals Handbook* (*Amer. Soc. Metals*), 1936, 1075–1077).—Curves are given of hardness, tensile properties, density, electrical and thermal conductivity, and thermal expansion. A table gives data for Rockwell hardness, tensile strength, and elongation for 10 brasses in various tempers; typical uses are indicated.—S. G.

Wrought Admiralty Metal. William B. Price (*Metals Handbook* (*Amer. Soc. Metals*), 1936, 1354–1355).—Deals briefly with the properties, machinability, uses, specifications, and corrosion-resistance of the alloy containing copper not less than 70·00, tin 0·90–1·20, lead not more than 0·075, iron not more than 0·06%, zinc remainder. The tensile properties at elevated temperatures are shown in a diagram.—S. G.

The Problem of Finding Hardenable Copper Alloys. A. A. Botchvar and I. I. Shaposhnikov (*Zvetnye Metally* (*Non-Ferrous Metals*), 1936, (9), 95–97).—[In Russian.] Brasses containing aluminium (zinc 25, aluminium 3·5–5%) are capable of hardening. The method consists in quenching from 800°–850° C., and annealing at 250° C. for 2 hrs. The hardening effect is especially pronounced if small quantities of silicon (0·25%) or manganese (1–1·5%) are added.—N. A.

†**The Constitution of Gold–Copper Alloys.** Oscar E. Harder (*Metals Handbook* (*Amer. Soc. Metals*), 1936, 1138–1144).—A critical review of the literature, with a *bibliography* of 58 references. Two diagrams are given—in atomic and weight percentages—based on the work of various investigators. Hardness and electrical resistance curves of slowly-cooled and quenched alloys are given according to Kurnakow *et al.* (*J. Inst. Metals*, 1916, 15, 305).—S. G.

***X-Ray Determination of the Solubility of Mercury in Solid Gold.** M. I. Zaharova (*Zhurnal Technicheskoy Fiziki* (*J. Tech. Physics*), 1937, 7, (2), 171–174).—[In Russian.] X-ray examination by Preston's method of alloys of gold with up to 18 atomic-% mercury after annealing at 218° C. for 15 days, at 300° C. for 4 days, and at 400° C. for 8 hrs. indicates that the solubility of mercury in gold at these temperatures is 16, 16·95, and 17·3 atomic-%, respectively. The lattice parameter of pure gold, 4·0687 A., is increased to 4·1094, 4·1116, and 4·1126 A., respectively, by the foregoing percentages of mercury. No accurate measurements of the solubility at lower temperatures were possible owing to the slow rate of diffusion and consequent difficulty of obtaining homogeneity.—N. A.

The White Gold Jewellery Alloys. A. W. Paterson (*Metals Handbook* (*Amer. Soc. Metals*), 1936, 1356–1357).—Briefly discusses the constitution, physical and mechanical properties, technology, fabrication, wear- and corrosion-resistance of these alloys.—S. G.

Constitution of Gold–Silver Alloys. Robert H. Leach (*Metals Handbook* (*Amer. Soc. Metals*), 1936, 1145).—A review of the literature, with a *bibliography* of 10 references. The diagram of Broniewski and Wesołowski ((*Met. Abs.*) *J. Inst. Metals*, 1932, 40, 474) is reproduced on a small scale.—S. G.

***Magnetic Properties of Alloys of Iron with Iridium.** Maurice Fallot (*Compt. rend.*, 1937, 205, (12), 517–518).—The alloys in the body-centred cube α-region are ferromagnetic up to 15 atomic-% iridium (37·8% by weight). From 0 to 2 atomic-%, the alloys are reversible in the region of the Curie points. From 2 to 5 atomic-%, their Curie points are easily observable at increasing temperatures, but at decreasing temperatures they are detected only if the

temperature of the $\alpha \longrightarrow \gamma$ transformation has not been exceeded during heating. Above 5%, the Curie points of the α-state are not directly observable. The Curie points diminish as the iridium content increases, the rate of variation, 4° C. per atom of iridium introduced, being intermediate between that of iron–platinum (0° C.) and iron–osmium (11° C.). The mean atomic moment increases linearly with the iridium content. The maximum mean moment is 11·3 Weiss magnetons at 7% iridium, compared with 12·25 magnetons for iron–platinum at 12·5% platinum. Above this composition, the mean moment diminishes very rapidly as the iridium content increases, and thus this system resembles iron–osmium and iron–ruthenium, rather than iron–platinum.
—J. H. W.

†**Constitution of Lead–Antimony Alloys.** R. S. Dean (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1154–1155).—A brief review of the literature, with a *bibliography* of 13 references. A diagram is given, based on the work of various investigators.—S. G.

The Properties of Lead–Antimony Alloys. Earle E. Schumacher and G. O. Hiers (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1168–1175).—Discusses the properties of the lead-rich alloys. Diagrams show the solidification shrinkage and volume change with temperature, conductivity of extruded wires, thermal conductivity, density, tensile strength, and tensile strength of extruded wires. Physical and mechanical properties are tabulated. A *bibliography* of 48 references is appended.—S. G.

***Endurance Tests with Internal Pressures on Antimonial Lead.** (Frhr.) von Göler (*Metallwirtschaft*, 1937, **16**, (32), 797–801).—In short-time bursting tests on pipes made of lead, and of lead with up to 1·5% antimony, the tangential stresses producing failure and the tensile strength are approximately of equal magnitude. The stresses increase from 1·5 kg./mm.^{2} for soft lead to 2·9 kg./mm.^{2} for the 1·5% antimony alloy. In long-time endurance tests the bursting stresses are lower, and it is found that the logarithm of the life of the pipe increases proportionally with decrease in stress. A stress of the magnitude of the 0·2% elastic limit produces fracture in 1–5 months. With antimonial lead, in long-time tests the stress which will just produce fracture in a given period is a smaller fraction of the short-time bursting stress. The higher the antimony content the smaller this fraction; thus a decrease in stress of 0·2 kg./mm.^{2} will increase the life of a lead pipe tenfold, whereas for the 1·5% antimony alloy the stress must be decreased by 0·4 kg./mm.^{2} to produce a similar increase in life. Because of this, at stresses under 0·5 kg./mm.^{2}, or with times of about a year, the presence of antimony in lead pipe is no longer of service.—v. G.

***On the Question of the Creep Limit of Lead–Antimony Alloys.** H. Hanemann, K. von Hanffstengel, and W. Hofmann (*Metallwirtschaft*, 1937, **16**, (38), 951–954).—The low creep limit of antimonial lead is appreciably increased by addition of about 0·05% arsenic, and the material can then be more severely age-hardened.—v. G.

Crystallization, Creep, and Age-Hardening of Lead and Antimonial Lead. (——.)—See p. 583.

†**Constitution of Lead–Bismuth Alloys.** W. A. Cowan and G. O. Hiers (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1156).—A brief review of the literature, with a *bibliography* of 7 references. A diagram is given, based on the work of various investigators.—S. G.

†**Constitution of Lead–Cadmium Alloys.** W. A. Cowan and G. O. Hiers (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1157).—A brief review of the literature, with a *bibliography* of 5 references. A diagram is given, based on the work of various investigators.—S. G.

†**Constitution of Lead–Calcium Alloys.** Earle E. Schumacher and G. M. Bouton (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1158–1159).—A brief

review of the literature, with a *bibliography* of 7 references. A diagram is given, based on the data of Donski and of Baar.—S. G.

***Polymorphic Transitions of 35 Substances to 50,000 Kg./Cm.^{2} [PbSe; PbTe].** P. W. Bridgman (*Proc. Amer. Acad. Arts Sci.*, 1937, 72, (2), 45–136).—The polymorphic transformations of a number of inorganic compounds were studied at pressures up to 50,000 kg./cm.^{2}. The intermetallic compounds PbSe and PbTe gave negative results, *i.e.* no transition occurred.
—W. H.-R.

†Constitution of Lead–Tin Alloys. W. A. Cowan and G. O. Hiers (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1160–1161).—A brief review of the literature, with a *bibliography* of 10 references. A small-scale diagram is given, based on the results of various investigators.—S. G.

Properties of Lead–Tin Alloys. George O. Hiers (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1176–1179).—Discusses and gives curves for density, tensile properties, hardness, creep, fatigue, and volume shrinkage on solidification, specific volume/temperature, electrical resistance, thermal conductivity, and coeff. of linear expansion. A *bibliography* of 11 references is appended.—S. G.

***On the Rate of Melting [of Lead–Tin, Cadmium–Zinc, and Silver–Copper Eutectic Alloys].** (Tammann.)—See p. 588.

Lead-Base Bearing Alloys. Leland E. Grant (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1180–1182).—Discusses the effects of antimony, tin, copper, arsenic, and of impurities; Brinell hardness; compression strength; casting properties; and lead–calcium bearing alloys.—S. G.

Properties of Lithium and Its Alloys. (Osborg.) See p. 583.

†Constitution of Magnesium–Aluminium Alloys. H. E. Bakken and R. T. Wood (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1197–1198).—A review of the literature concerning the magnesium-rich alloys, with a *bibliography* of 11 references. The diagram of Hanson and Gayler (for the magnesium-rich alloys) is given, in which the line of solid solubility of aluminium in magnesium is changed to conform to the data of Schmidt, Seliger, and Siebel.—S. G.

Influence of Pressure on the Crystallization and Structure of [Elektron] Alloys Cast Under Pressure. K. V. Peredelsky (*Aviopromishlennost* (*Aero. Ind.*), **1937**, (1), 24–26).—[In Russian.] Pressure-casting of Elektron containing aluminium 10·68 and manganese 0·2% appreciably decreases the grain-size, as compared with chill-casting. Increase of the pressure from 143·5 to 576 kg./cm.^{2} has no further effect.—N. A.

Properties of Magnesium–Aluminium Alloys (Containing Small Amounts of Manganese). R. T. Wood (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1210–1214).—Discusses the density, thermal conductivity, electrical resistance, thermal expansion, growth, casting characteristics, mechanical properties, working characteristics, and corrosion-resistance, and gives curves for the density, thermal conductivity, electrical resistance, linear contraction, tensile strength (sand-cast and after solution heat-treatment), and mechanical properties of extruded metal of the magnesium-rich alloys. A *bibliography* of 7 references is appended.—S. G.

***Magnesium Alloys with Addition of Antimony.** K. V. Peredelsky (*Aviopromishlennost* (*Aero. Ind.*), **1937**, (2), 42–47).—[In Russian.] Alloys of magnesium with up to 10·18% antimony are readily prepared; they are relatively stable in the air and have satisfactory casting properties. A maximum tensile strength of 16·3 kg./mm.^{2} is obtained with 0·23% antimony, and a maximum elongation of 13·1% with 0·09% antimony. Addition of antimony increases the hardness rapidly and the resistance to corrosion by soft water considerably, but sharply increases the resistance to corrosion by sea-water. The alloys can be extruded comparatively easily. Forged alloys with up to 0·34% antimony have a tensile strength of up to 26·4 kg./mm.^{2}

with an elongation of 3·5%. Alloys with 0·1–0·23% antimony are recommended for commercial use.—N. A.

***Influence of Beryllium on the Crystallization and Structure of Magnesium Alloys.** K. V. Peredelsky (*Aviopromishlennost* (*Aero. Ind.*), **1937**, (4), 27–32).—[In Russian.] The alloys studied contained 8% aluminium and 0·01–0·048% beryllium. Graphs are given to show the relation between grain-size, beryllium content, and mould temperature. Beryllium produces considerable grain-refinement when the mould temperature does not exceed 200° C.; as this temperature is increased, the effect of beryllium decreases, until at 450° C. there is no longer any effect. For any given alloy, grain-size increases with increasing mould temperature, the best results being obtained at 150°–200° C. The presence of beryllium produces some grain-growth on annealing the alloys at 400° C. for 72 hrs. *in vacuo*.—N. A.

***Influence of Beryllium on the Crystallization and Structure of Alloys of the Elektron Type.** K. V. Peredelsky (*Metallurg* (*Metallurgist*), **1937**, (5), 114–118).—[In Russian.] See preceding abstract.—N. A.

***The Rate of Polymorphic Transformation of the Compound MgCd in the System Magnesium–Cadmium.** I. I. Kornilov (*Izvestia Akademii Nauk S.S.S.R.* (*Bull. Acad. Sci. U.R.S.S.*), **1937**, [Chim.], (2), 313–330; English summary, 330–331).—[In Russian.] Cf. *Met. Abs.*, 1936, **3**, 514. Measurements of the electrical resistance and specific volume with increase in temperature indicate that the $\alpha \rightleftharpoons \beta$ transformation point of MgCd is at 258° C. Photomicrographs show that the transformation begins at the grain-boundaries, and proceeds inward, the rate of transformation varying for the various grains. The hardness reaches a sharp maximum at the beginning of the transformation, and then decreases slowly.—N. A.

Influence of Calcium on Magnesium Alloys. K. V. Peredelsky (*Vestnik Ingenerov i Technikov* (*Messenger Eng. and Tech.*), **1936**, (11), 670–672).—[In Russian.] Addition of a little calcium to molten 8% aluminium–magnesium alloy reduces its tendency to oxidize to such an extent that it can be cast without applying a protective sulphur coating to the mould. The calcium slightly reduces the tensile strength, but the elongation, corrosion-resistance, and hardness are not affected. The protective effect of calcium does not extend above 700°–710° C., and the alloy should be protected from access of air during the first stages of melting. Calcium actually improves the resistance to attack by moist air.—N. A.

***Alloys of Magnesium. VI.—The Constitution of the Magnesium-Rich Alloys of Magnesium and Calcium.** J. L. Haughton (*J. Inst. Metals*, 1937, **61**, 241–246).—The constitution of these alloys was redetermined. The eutectic point occurs at 16·2% calcium, and at 517° C. Magnesium dissolves about 1·8% calcium at the eutectic temperature, and about 0·5% at 250° C.—J. L. H.

Constitution of Magnesium–Copper Alloys. John A. Gann and Manley E. Brooks (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1199–1200).—A review of the literature, with a *bibliography* of 11 references. The diagram of W. R. D. Jones (*J. Inst. Metals*, 1931, **46**, 395) is reproduced.—S. G.

***On the Ternary Compound $Mg_4Cu_{11}Al_{11}$.** W. Schütz (*Metallwirtschaft*, 1937, **16**, (38), 949–950).—Thermal analyses of alloys of magnesium, copper, and aluminium having a composition close to that of the ternary compound indicate that the composition of this compound is $Mg_4Cu_{11}Al_{11}$, which is more closely in agreement with theoretical expectations than the formulæ previously suggested.—v. G.

†Constitution of Magnesium–Manganese Alloys. H. E. Bakken and R. T. Wood (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1201–1202).—A review of the literature, with a *bibliography* of 6 references. The partial diagrams of Ruhrmann and of Schmidt, Seliger, and Siebel are reproduced.—S. G.

Nature of the Iron–Manganese Alloys. Francis M. Walters, Jr. (*Metal Progress*, 1937, **32**, (3), 254–256).—The alloy systems manganese–iron and nickel–iron are compared and contrasted; the constitutional diagrams of Walters and Wells and of Merica are reproduced.—P. R.

***Pseudo-Binary Magnesium Alloys.** K. V. Peredelski (*Legkie Metally* (*Light Metals*), 1937, **6**, (3), 27–29).—[In Russian.] A preliminary note on the mechanical properties of SbSn–magnesium and Pb_4Sn_3–magnesium alloys, containing up to 20% SbSn or Pb_4Sn_3, respectively.—D. N. S.

***X-Ray Investigation of Magnesium–Silver Alloys.** N. W. Ageew and V. G. Kuznetzov (*Izvestia Akademii Nauk S.S.S.R.* (*Bull. Acad. Sci. U.R.S.S.*), **1937**, [Chim.], (2), 289–309; English summary, 309–311).—[In Russian.] Cf. *Met. Abs.*, this vol., p. 331. The existence of 4 phases in the system magnesium–silver is confirmed. The α-solid solution extends to 28 atomic-% magnesium, and its parameter increases linearly with increasing magnesium content. The β-phase, with a body-centred cubic lattice, is homogeneous between 47 and 55 atomic-% silver. Since the two kinds of atoms are regularly distributed at the lattice points, and maximum degree of order is shown by the alloy with 50 atomic-% silver, this phase appears to be MgAg, in which both silver and magnesium have limited solubilities. The γ-phase is a solid solution of magnesium in $AgMg_3$; it extends from 20·5 to 25 atomic-% silver, and has a hexagonal lattice, with 8 atoms per unit cell. The δ-phase is a solid solution of silver in magnesium, with a close-packed hexagonal lattice, the solubility of silver increasing from 0·2 atomic-% at 260° C. to 3·0 atomic-% at 440° C.—N. A.

***Magnesium Alloys with Additions of Silver.** K. V. Peredelsky (*Aviopromishlennost* (*Aero. Ind.*), 1937, (5), 30–31).—[In Russian.] Up to 0·5% silver in magnesium decreases the oxidizability to such an extent that it becomes possible to melt the metal with a very small amount of flux, and to cast the alloy satisfactorily at 720°–730° C. without taking any protective measures. An alloy with silver 0·63 and copper 0·44% has a tensile strength of 20·4 kg./mm.^{2}. All the alloys studied also contained copper, since the silver was introduced as a copper–silver " hardener " alloy.—N. A.

†Constitution of Magnesium–Zinc Alloys. John A. Gann and Manley E. Brooks (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1203–1204).—A review of the literature, with a *bibliography* of 20 references. The diagram of Chadwick (*J. Inst. Metals*, 1928, **39**, 285) is reproduced, modified by the work of Hume-Rothery and Rounsfell, Grube and Burkhardt, Schmid and Seliger, and Schmidt and Hausen.—S. G.

Properties of Magnesium Casting Alloys. John A. Gann (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1215–1217).—Heat-treatment, casting characteristics, die-casting, general characteristics, and uses are briefly discussed. Tables give the trade designations and society nomenclature, as well as the physical properties of castings, of these alloys.—S. G.

***The Electrical Resistance of Manganese Amalgams.** L. F. Bates and P. G. Day (*Proc. Phys. Soc.*, 1937, **49**, (6), 635–641).—The variation with temperature of the electrical resistance of 5 manganese–mercury amalgams containing 0·01–0·15% manganese (by weight) is studied at $-78°$ to 340° C. The data are correlated with magnetic susceptibility data.—J. S. G. T.

***The Magnetic Properties of Silver Amalgams.** L. F. Bates and A. W. Ireland (*Proc. Phys. Soc.*, 1937, **49**, (6), 642–645).—The magnetic susceptibilities of silver amalgams containing 0–5% (by weight) silver are determined. Silver enters into solution in mercury with a molar susceptibility of about -18×10^{-6} c.g.s. units in very dilute amalgams, and -77×10^{-6} c.g.s. units in more concentrated amalgams, instead of the value $-21{\cdot}6 \times 10^{-6}$ usually found for solid silver.—J. S. G. T.

***Decomposition of the Supersaturated Solid Solution of Molybdenum in Iron.** B. G. Livshiz and L. M. Lvova (*Zhurnal Technicheskoy Fiziki* (*J. Tech. Physics*), 1937, 7, (5), 498–500).—[In Russian.] The hardness, coercivity, and magnetic saturation of a 14·7% molybdenum–iron alloy prepared by powder metallurgy were determined after heating to 1200° C. and (*a*) annealing at 500°–900° C., and (*b*) quenching and reheating at 500°–900° C. The hardness and coercivity were somewhat greater after treatment (*b*) than after treatment (*a*), but no changes occur in these properties until precipitation commences.—N. A.

Constitution of Nickel–Aluminium Alloys. N. B. Pilling and T. E. Kihlgren (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1240).—The nickel-rich end of Gwyer's diagram is reproduced.—S. G.

***On the Nickel–Aluminium Equilibrium Diagram.** Hideo Mishimura and Satoshi Watanabe (*Japan Nickel Rev.*, 1937, 5, (4), 552–559).—[In English and Japanese.] From *Suiyokwai-Shi*, 1937, 9, (3), 153–158 (in Japanese); see *Met. Abs.*, this vol., p. 234.—S. G.

***The Constitution of the Nickel–Aluminium System.** W. O. Alexander and N. B. Vaughan (*J. Inst. Metals*, 1937, **61**, 247–260; discussion, 260–263).—The system nickel–aluminium was studied by thermal and micrographic methods, and a hitherto unsuspected phase was found to exist, containing 84·5–87% nickel, and probably corresponding to the intermetallic compound Ni_3Al (86·7% nickel). Otherwise the diagram remains substantially as determined by Gwyer, except that the compound described by Gwyer as $NiAl_2$ is shown to be Ni_2Al_3. A change in solubility of nickel in NiAl causes alloys with 80–85% nickel to exhibit a suppressed structure when quenched from temperatures exceeding 1150° C., and to undergo hardness changes on heat-treatment similar to those which occur in the suppressed β-phase of the copper–aluminium system. Some preliminary observations suggest that the nickel-rich alloys may possess desirable heat-resisting properties.—W. O. A.

Constitution of Nickel–Beryllium Alloys. D. E. Ackerman (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1241).—Masing and Dahl's diagram is reproduced and briefly discussed.—S. G.

Constitution of Nickel–Carbon Alloys. N. B. Pilling and T. E. Kihlgren (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1242–1243).—A review of the literature, with a *bibliography* of 8 references. The nickel end of the diagram of Kasé (*J. Inst. Metals*, 1925, **34**, 440) is reproduced.—S. G.

Constitution of Nickel–Chromium Alloys. N. B. Pilling (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1244–1245).—A review of the literature, with a *bibliography* of 11 references. The diagram of Matsunaga (*J. Inst. Metals*, 1929, **42**, 459) is reproduced, and another diagram illustrates the results of various investigators on the solubility of nickel and chromium.—S. G.

†Constitution of Nickel–Cobalt Alloys. D. E. Ackerman (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1246–1247).—A review of the literature, with a *bibliography* of 16 references. A diagram is given, based on the work of Guertler and Tammann and Ruer and Kaneko, corrected for the currently-accepted values of the melting points and Curie temperatures of the pure metals. A table of lattice constants is given.—S. G.

Properties of Monel Metal. W. F. Burchfield (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1263–1271).—A full review of the physical and mechanical properties, corrosion-resistance, working properties, etc., of Monel metal and "K" Monel metal.—S. G.

The Properties of Monel. —— (*Nickel Bull.*, 1937, **10**, (3), 56–57; and *Monel Notes*, 1937, **2**, 22–23).—The physical and mechanical properties of Monel metal are tabulated.—S. G.

K Monel. —— (*Monel Notes*, 1937, (4), 58–59).—Briefly deals with the magnetic properties, physical constants, mechanical properties, endurance, strength at elevated temperatures, heat-treatment, machining, and uses of the alloy.—S. G.

***Effect of Titanium on Some Cast Ferrous and Non-Ferrous Metals [Nickel Alloys].** Joseph A. Duma (*Trans. Amer. Soc. Metals*, 1937, **25**, (3), 788–818; discussion, 819–825).—The effect of titanium additions to various steels, and to "straight" and "inverted" Monel metals, was studied by tensile, Brinell hardness, notch-impact, corrosion, and magnetic tests. Addition of $<$ 0·2% to low-carbon irons and medium carbon steels minimizes nitrogen content, blow-holes, and slag inclusions, and increases tensile strength, yield-point, and hardness, with only a slight decrease of ductility and notch-impact resistance. Additions of 0·2–0·6% cause brittleness, the microstructure consisting of coarse titanium carbide crystals in a soft ferrite matrix. Additions up to 0·4% to nickel–chromium steels increase hardness and tensile strength, but above 0·2% the ductility falls sharply. For 18–8 stainless steel hardness and tensile properties are improved up to 3·5% added titanium. Ductility decreases slowly up to 0·6%, then rapidly up to 1·0%. The formation of austenite is suppressed and that of α–δ-ferrite promoted, intergranular corrosion being strongly inhibited. Titanium additions to copper-bearing steels are disadvantageous, but the machinability and tensile properties of copper–nickel alloys are greatly improved, owing to the retention of carbon in the combined state and the prevention of graphitic fissures.—G. V. R.

***Thermal Expansion Curves and Transformation Points [of Iron–Nickel and Copper–Nickel Alloys].** Tsutomu Kase (*Oyo Butsuri* (*Applied Physics*), 1937, **6**, (4), 159–162).—[In Japanese.] Summarizes an experiment on iron–nickel and copper–nickel alloys. The Ar_2 and Ar_3 points of iron–nickel alloys were determined by thermal expansion, and the Ar_2 point of copper–nickel alloys by magnetic analysis.—S. G.

***The Structure of Iron–Nickel Alloys.** W. Broniewski and J. Smoliński (*Prace Zakładu Metalurgicznego Politechniki Warsawskiej*, 1934, **4**, 85–99).—[In Polish, with French summary.] See *Met. Abs.* (*J. Inst. Metals*), 1933, **53**, 438.—S. G.

***Magneto-Resistance Effect of Iron–Nickel Magnetic Alloys and Permalloy.** Kingo Mihara (*Denki Gakkukai Zasshi* (*J. Inst. Elect. Eng. Japan*), 1937, **57**, (589), 627).—[In Japanese.] The change of electrical resistance, in the direction parallel to magnetization, in nickel–iron alloys was measured to examine the inner structure. It is suggested that complexes in Permalloy have a uniform strain and are magnetically isotropic.—S. G.

On a Magnetic Alloy, NC Alloy. —— (*Kogyo Nippon* (*Japan Indust. Outlook*), 1937, **5**, (3), 61–63).—[In Japanese.] NC alloy (nickel–iron–tin–chromium), has been developed by Tadashi Masuko as a less expensive substitute for Super-Permalloy. Its main features are high permeability, high magnetic saturation, high specific resistance and little core loss, and ease in heat-treatment.—S. G.

The Properties of Some Nickel–Iron High-Permeability Alloys. —— (*Nickel Bull.*, 1937, **10**, (4), 76).—The properties of Mumetal, Radiometal, Rhometal, "2129" alloy, Permalloy B, and Permalloy C are tabulated, and data are given for Armco iron and silicon steel, for comparison.—S. G.

The Properties of Inconel. —— (*Nickel Bull.*, 1937, **10**, (5), 105).—The physical and mechanical properties of the alloy are tabulated.—S. G.

The Properties and Uses of Inconel. —— (*Monel Notes*, 1937, (5), 70–73).—The mechanical, physical, and working properties, metallic arc- and gas-welding, and uses are briefly discussed.—S. G.

The Properties of Ferry. —— (*Nickel Bull.*, 1937, **10**, (10), 213).—The physical and mechanical properties of the alloy are tabulated.—S. G.

***The $L\alpha$-Lines of Some Nickel Alloys.** F. C. Chalklin and S. P. Hillson (*Phil. Mag.*, 1937, [vii], **24**, (159), 190–195).—The $L\alpha$ emission lines of nickel were measured, using anticathodes of: (*a*) commercial nickel; (*b*) copper–nickel alloys containing 40 and 55% copper, respectively; (*c*) Radiometal (nickel 48, iron 50, copper 2%); and (*d*) Mumetal (nickel 76, iron 17, copper 5, chromium 1·5%). No differences in the wave-lengths could be detected, and this shows that the $M_{IV,V}$ level of nickel is not affected when the magnetic condition is altered by alloying with another metal. The copper $L\alpha$ lines were also unaffected, but the experimental accuracy was not so great.—W. H.-R.

†**Constitution of Nickel–Manganese Alloys.** N. B. Pilling (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1248–1249).—A review of the literature, with a *bibliography* of 7 references. The diagram of Dourdine (*Met. Abs.* (*J. Inst. Metals*), 1933, **53**, 14) is reproduced.—S. G.

Properties of Nickel–Manganese Alloys. W. A. Mudge (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1261–1262).—Discusses briefly the chemical, mechanical, and other properties, and annealing treatment, and tabulates the compositions, tensile properties, torsional properties, and hardness of hot-rolled rods and the electrical properties of different grades.—S. G.

†**Constitution of Nickel–Silicon Alloys.** D. E. Ackerman (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1250–1251).—A review of the literature, with a *bibliography* of 3 references. A diagram is given in which the data of Dahl and Schwartz have been used for the α-field boundary, whilst the remainder is based on the work of Guertler and Tammann.—S. G.

†**The Constitution of Nickel–Sulphur Alloys.** D. E. Ackerman (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1252–1253).—A review of the literature, with a *bibliography* of 6 references. A diagram (0–31% sulphur) is given based chiefly on the work of Bornemann and of Guertler and Savelsberg, although the work of Merica and Waltenberg is taken into consideration in locating provisionally the limits of the α-field.—S. G.

†**Constitution of Nickel–Zinc Alloys.** D. E. Ackerman (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1254–1256).—A review of the literature, with a *bibliography* of 11 references. The diagram of Heike, Schramm, and Vaupel (*Met. Abs.* (*J. Inst. Metals*), 1933, **53**, 17, 760) is reproduced.—S. G.

On the Transformation of Nickel Alloys. Tsutomu Kase (*Oyo Butsuri* (*Applied Physics*), 1937, **6**, (1), 6–8).—[In Japanese.] Describes the relation between the transformation point and thermal expansion in binary and ternary iron–nickel alloys, referring to the improvement of Invar-type alloys.
—S. G.

***A Theoretical Formula for the Solubility of Hydrogen in Palladium.** John R. Lacher (*Proc. Roy. Soc.*, 1937, [A], **161**, (907), 525–545).—A theory of the absorption of hydrogen by palladium is developed on the assumption that the dissolved hydrogen is almost completely ionized, and that the electrons enter the *d*-band of the palladium, which is completely filled when between 0·55 and 0·60 electron per atom have been added. It is assumed that there are potential energy holes in the metal for the hydrogen to enter, and that the energy of adsorption increases as the number of holes filled increases. The problem thus formulated is similar to that of the theories of order–disorder transitions in solid solutions (superlattice formation), where the energy change is assumed to increase with the degree of order. The theory gives a critical temperature above which only one solid phase can exist, and below which two solid phases may be in equilibrium with one another for certain concentrations of dissolved hydrogen. The hysteresis phenomena are discussed, and also the relative solubilities of hydrogen and deuterium.—W. H.-R.

***Alloys of Platinum with Ruthenium.** W. A. Nemilov and A. A. Rudnizky (*Izvestia Akademii Nauk S.S.S.R.* (*Bull. Acad. Sci. U.R.S.S.*), **1937**, [Chim.], (1), 33–38; German summary, 39–40).—[In Russian.] Curves showing the hardness and temperature coeff. of electrical resistance of the alloys of platinum with up to 80 atomic-% ruthenium, and the electrical conductivity and thermoelectric power against pure platinum of alloys with up to 9 atomic-% ruthenium, indicate that the metals form a continuous series of solid solutions. This conclusion is confirmed by the microstructure of the alloys.—N. A.

***Magnetic Properties of Iron with Rhodium.** Maurice Fallot (*Compt. rend.*, 1937, **205**, (14), 558–560).—From 0 to 6·5%, the alloys are reversible near their Curie points, which diminish slightly (2° C. per atom of rhodium). The irreversible transformations $\alpha \rightleftharpoons \gamma$ occur at temperatures which, while still above the Curie points, decrease as the content increases. The amount of variation is very rapid at the beginning. Hence, from 6·5 to 23%, the Curie point of the alloys in the α-state is not observable; the disappearance of spontaneous magnetism is due to the change of the body-centred cubic lattice to face-centred cubic. After passing through a minimum, the $\alpha \longrightarrow \gamma$ transformation temperature increases rapidly while the $\gamma \longrightarrow \alpha$ transformation occurs at a temperature which increases slightly with the rhodium content. Between 23 and 28% the Curie point can be observed during heating, but not during cooling. Above 28%, the transformations are again reversible near their Curie points, which diminish more and more rapidly as the rhodium content increases. The mean atomic moment increases with the rhodium content, and is intermediate between those of iron–iridium and iron–cobalt. The maximum value is 12 Weiss magnetons at 20% rhodium and is comparable with those of iron–platinum and iron–cobalt. The mean atomic moment is higher than that of pure iron up to 40% rhodium.—J. H. W.

***The Precipitation Hardening of Sterling Silver.** Arthur Gordon Dowson (*Abstracts Dissertations Univ. Cambridge*, **1936–1937**, 115–116).—It has been shown experimentally that the precipitation-hardening of sterling silver has no ill effect on the polishing of the material and little on the working properties. The deterioration which takes place when metal containing oxide is annealed in reducing atmospheres has been investigated. The oxygen is probably taken up chiefly during annealing.—A. G. D.

***On the Mechanical Properties of Polish Coinage Silver.** W. Broniewski and M. Ziebiński (*Ann. Acad. Sci. Tech. Varsovie*, 1935, **2**, 199–208).—A study was made of the influence of temperature and cold-work on the mechanical properties of an alloy of silver 75 and copper 25%. Measurements were made on the tensile strength, elastic limit, reduction in area, elongation, hardness, and impact strength. Three quaternary alloys composed of silver, copper, zinc, and nickel were also examined, and the best mechanical properties were obtained with an alloy made from equal quantities of silver and a nickel silver of the composition copper 55, nickel 20, zinc 25%.—N. S.

***On the Heat-Treatment and Cold-Working of Silver–Copper Alloys containing $940^{\circ}/_{\circ\circ}$ of Silver.** W. Broniewski and M. Perlberg (*Ann. Acad. Sci. Tech. Varsovie*, 1937, **4**, 227–233).—On account of the softness of the silver–copper alloy containing 94% silver, the 80% alloy is ordinarily used in the manufacture of table silver, this having a Brinell hardness in the neighbourhood of 65. The annealed 94% alloy has a Brinell hardness of about 40, a tensile strength of about 24 kg./mm.^{2}, and an extension at fracture of 28%. Tempering at 750° C. causes copper to go into solid solution with the silver, but scarcely modifies the mechanical properties of the alloy. Subsequent ageing at 350° C. for 30 minutes, however, increases the Brinell hardness to 95, the tensile strength to 36 kg./mm.^{2}, whilst the extension is about 19%. Whereas the 80% alloy requires immersion in dilute sulphuric acid, superficially to remove the yellowish tinge, the 94% alloy has a beautiful silver lustre which renders this process, which is in other respects detrimental to the alloy, unnecessary. The tempered and aged 94% alloy can therefore be used in the manufacture of table silver, which then has a Brinell hardness of about 110, a tensile strength of 50 kg./mm.^{2}, an extension of 5%, and an elasticity sufficient for practical use.—P. W. R.

Indium-Containing Silver Alloys. E. Raub and H. Roters (*Mitt. Forschungsinst. Edelmetalle*, 1937, **11**, (2/3), 13–19).—Alloys of silver with up to 20% indium are workable, those containing not more than about 10% indium being capable of being rolled to 0·2 mm. sheet with intermediate annealing. Alloys with more than 20% indium are hot-short. Addition of indium to silver or to copper–silver alloys has no effect on their resistance to tarnishing by sulphides, but renders the alloys less resistant to acids except nitric acid, dissolution in which is retarded by the presence of indium. Alloys with 1–2% indium are slightly more resistant than pure silver to dilute acetic acid.—A. R. P.

†**Constitution of Tin–Antimony Alloys.** W. A. Cowan and G. O. Hiers (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1289–1290).—A review of the literature, with a *bibliography* of 12 references. A diagram is given, based on the work of various investigators.—S. G.

***The Constitution of Tin-Rich Antimony–Cadmium–Tin Alloys.** D. Hanson and W. T. Pell-Walpole (*J. Inst. Metals*, 1937, **61**, 265–307).—The constitution of antimony–cadmium–tin alloys containing up to 43% of cadmium and 14% of antimony has been established by thermal and microscopical analyses. The results are presented as isothermal diagrams of the various surfaces, and as vertical and horizontal sections through the constitutional model. There are three ternary peritectic reactions at 227°, 209°, and 180° C., respectively. Metastable conditions occur during cooling in parts of the system, but these have been related to the stable state which is obtained by prolonged annealing of specimens. It is shown that at 227° C. tin will dissolve 9% of antimony with 1·5% of cadmium, and at 209° C. 5·5% of antimony with 2·4% of cadmium; below 209° C. the solubilities decrease continuously to 1% of antimony with 0·7% of cadmium at 148° C., and to 0·6% of each metal at 20° C. The solubility of antimony in the β-phase of the cadmium–tin system is shown to decrease from 5·1% at 209° C. to 0·8% at 145° C. The surface of the eutectoid decomposition of β has been determined by thermal and microscopical analyses.—D. H.

***A Study of the Mechanical Properties of Tin-Rich Antimony–Cadmium–Tin Alloys.** D. Hanson and W. T. Pell-Walpole (*J. Inst. Metals*, 1937, **61**, 123–139; discussion, 140–142).—The tensile strength and Brinell hardness of alloys containing up to 43% of cadmium and 14% of antimony were determined on annealed chill-cast specimens. The results are correlated with the constitution of the alloys. Maximum stable values obtained are: tensile strength 7·0 tons/in.^{2} and Brinell hardness 36. Tin-rich alloys containing 3% to 8% of cadmium with 1% to 9% of antimony have been tested as rolled and after various heat-treatments. Two forms of hardening are obtained by quenching from suitable temperatures. One form is due to the solubility change of antimony in tin or in β; the other, which produces much more intense hardening, is analogous to the hardening of binary cadmium–tin alloys by quenching and depends on the suppression of the eutectoid decomposition of the β-phase. Permanent improvement results in the first case, but the second type of hardening is only temporary, since complete self-annealing occurs at normal temperature (18° C.) within 18 months. Tempering experiments were carried out to obtain permanently stable properties by short-time heat-treatments.—D. H.

Constitution of the Tin–Antimony–Copper Alloys Used as Bearing Metals. O. W. Ellis (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1297–1298).—A review of the literature having a bearing on the constitution of these alloys, with a *bibliography* of 9 references. No diagram has yet been published.—S. G.

Structure of Tin–Antimony–Copper Alloys Used as Bearing Metals. O. W. Ellis (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1299–1302).—S. G.

Some Factors that May Determine the Service Life of Tin-Base Bearing Metals. D. J. Macnaughtan (*Inst. Mech. Eng. General Discuss. on Lubricants, Advance Copy*, 1937, (Group I), 170–178; and *Met. Ind.* (*Lond.*), 1937, **51**, (16), 380–383).—The nature of the failure of white-metal bearings is described. This frequently takes the form of cracks through the metal, together with cracks parallel to the white-metal/steel bond. These features of the defect are stated to be evidences of fatigue-cracking of white-metal. Brief reference is made to the fatigue strength of tin-base bearing metals, information concerning which is said to be lacking. Fatigue stresses in a bearing are considered, and the dissimilarity of the stresses imposed by a fatigue test and those arising in a bearing are described. M. advances 3 explanations to account for the tensile stresses set up in a bearing; the most probable explanation being that tension is set up in the white-metal as a result of differences in the coeffs. of thermal expansion of the white-metal and steel shell. Factors which contribute to this cause are considered. The effects of cadmium in certain proportions on the fatigue and tensile strengths, and of lead on the tensile strength, are considered. It is deduced that the permissible limit for cadmium addition to a 7% antimony and 3·5% copper tin-base alloy is about 2%, and, further, that the alloy should be as far as possible free from lead.—R. Gr.

Properties of Tin-Base Bearing Alloys. O. W. Ellis (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1310–1317).—A review of the literature, with a *bibliography* of 18 references. The effects of various elements on the microstructure, effects of cadmium on mechanical properties (illustrated by diagrams), and behaviour of the alloys at high temperatures are briefly discussed. The physical and mechanical properties are given, and the A.S.T.M. requirements as to chemical composition for several alloys are tabulated.—S. G.

†**Constitution of Tin–Bismuth Alloys.** W. A. Cowan and G. O. Hiers (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1291).—A brief review of the literature, with a *bibliography* of 9 references. A suggested diagram is given.—S. G.

†**Constitution of Tin–Cadmium Alloys.** W. A. Cowan and G. O. Hiers (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1292).—A review of the literature, with a *bibliography* of 8 references. A diagram is given, based principally on the work of Hanson and Pell-Walpole (*J. Inst. Metals*, 1935, **56**, 165; 1936, **59**, 281).—S. G.

†**The Constitution of Tin–Copper Alloys.** W. A. Cowan and G. O. Hiers (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1293–1294).—A review of the literature relating to the 0–50% copper alloys, with a *bibliography* of 15 references. A diagram is given, based on the work of Haughton (*J. Inst. Metals*, 1915, **13**, 222; 1921, **25**, 309).—S. G.

†**Constitution of Tin–Phosphorus Alloys.** W. A. Cowan and G. O. Hiers (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1295–1296).—The work of Vivian and of Haughton on the alloys containing 0–50% phosphorus is critically reviewed, and a diagram is given and discussed.—S. G.

***On the System Tungsten–Carbon.** Ursula Krawczynski (*Dissertation: Hochschule Breslau*, **1936**, 31 pp.).—The tungsten–carbon system was re-investigated by micrographic and X-ray examination of mixtures containing up to 6·10 weight-% carbon (corresponding to WC) sintered at 1450° and 1900° C. A short anneal at 1450° C. was not sufficient to produce equilibrium between the phases W, W_2C, and WC, but this process was readily effected at 1900° C. The system was further investigated by examination of tungsten wires carburized in an atmosphere of methane and hydrogen. The existence of a third carbide, W_3C, has been established; it decomposes on cooling into W + W_2C.—P. W. R.

†**Constitution of Zinc–Aluminium Alloys.** E. A. Anderson and M. L. Fuller (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1326–1328).—A review of the literature, with a *bibliography* of 32 references. The diagram of Hanson and Gayler is given, modified in the zinc solid solution region to include the work of Peirce.—S. G.

***On the Mechanical Properties of Zinc–Aluminium Alloys.** W. Broniewski and W. Kowalski (*Ann. Acad. Sci. Tech. Varsovie*, 1937, **4**, 216–226).—The mechanical properties of rolled zinc–aluminium alloys containing 0–25 and 76–100 weight-% aluminium were studied, after subjecting the specimens to varied heat-treatment. The alloys were cast from electrolytically-pure zinc and 99·6% aluminium. The zinc-rich alloys were either annealed for 30 minutes at 100° C. and cooled in air, or quenched from 350° C. after annealing for 1 hr. at that temperature. The quenched alloys were allowed to age for 3 weeks at room temperature. The aluminium-rich alloys were either annealed for 30 minutes at 400° C., or quenched from 540° C. after annealing for 1 hr. at that temperature, being then aged for 10 days at room temperature. The tensile strength, elastic limit, extension, constriction, hardness, and resilience of each specimen were then measured, and the Brinell coeff. and work of fracture calculated. The examination was extended to a similar series of alloys containing in addition 3% copper. It was found that, whereas the extension and constriction of pure zinc are reduced almost to zero by quenching, the extension of the binary alloy containing 18% aluminium is doubled by this treatment. For the aluminium-rich binary alloys, the tensile strength and elastic limit are increased by quenching, but the extension is considerably decreased, so that the work of fracture is also reduced. The hardness of the zinc-rich binary alloys, which is too small to permit their industrial use, is increased considerably by the addition of 3% copper, so that ternary alloys containing 7–25% aluminium satisfy all the conditions for industrial application. The addition of copper to the aluminium-rich alloys increases their hardness and tensile strength, but decreases their extension and resilience. Among the light aluminium–zinc alloys containing 3% copper, the best mechanical properties appear to be exhibited by the alloy with 14% zinc in the re-annealed state.—P. W. R.

†**The Constitution of the Zinc–Cadmium Alloys.** E. A. Anderson and D. C. Jillson (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1329–1330).—A brief review of the literature, with a *bibliography* of 32 references. A diagram is given, based on the work of various investigators.—S. G.

†**The Zinc-Rich Portion of the Zinc–Copper Constitution Diagram.** E. A. Anderson and J. L. Rodda (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1331–1332).—A brief review of the literature, with a *bibliography* of 18 references. The zinc-rich (0–8% copper) portion of the diagram is given, based on the work of Anderson, Fuller, Wilcox, and Rodda (*Met. Abs.*, 1934, **1**, 574).—S. G.

†**Constitution of Zinc–Iron Alloys.** E. A. Anderson and J. L. Rodda (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1333–1334).—A brief review of the literature, with a *bibliography* of 24 references. A diagram is given as constructed by Truesdale, Wilcox, and Rodda (*Met. Abs.*, 1935, **2**, 582) on the basis of a critical survey of the literature.—S. G.

†**Constitution of Zinc–Lead Alloys.** E. A. Anderson and R. L. Wilcox (*Metals Technology* (*Amer. Soc. Metals*), **1936**, 1335).—A brief review of the literature, with a *bibliography* of 11 references. A diagram is given, based on the work of various investigators.—S. G.

Constitution of Zinc–Magnesium Alloys. E. A. Anderson and D. C. Jillson (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1336–1337).—A brief review of the literature, with a *bibliography* of 28 references. The diagram given is that of Hume-Rothery and Rounsefell (*J. Inst. Metals*, 1929, **41**, 119), drawn from a combination of their own data and those of Chadwick and of Hansen.—S. G.

***Anisotropy of Diffusion of Mercury into Zinc.** M. A. Bolshanina and F. P. Ribalko (*Zhurnal Eksperimentalnoy i Teoreticheskoy Fiziki* (*J. Exper. Theoret. Physics*), 1937, **7**, (2), 312–317).—[In Russian.] The rate of diffusion of mercury into zinc was studied in the directions normal to the basal plane and normal to the prism of the first order. The depth of penetration is an exponential function of the temperature, and the diffusion coeff. does not depend on the crystallographic direction. The energy necessary for a mercury atom to diffuse into the zinc lattice is 22% greater normal to the basal plane than normal to the prism of the first order. The differences in the diffusion rates in different directions are thus due to differences in the activation energies. An explanation is advanced to account for the decrease in the anisotropy of diffusion with increasing temperature.—N. A.

The High-Zinc Portion of the Zinc–Nickel Constitution Diagram. E. A. Anderson and D. C. Jillson (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1338).—A review of the literature, with 3 references. Two small-scale diagrams show the solid solubility of nickel in zinc according to Peirce and to Heike, Schramm, and Vaupel.—S. G.

Nickel in Zinc Alloys. H. L. Evans. J. O. Hitchcock (*Met. Ind.* (*Lond.*), 1937, **50**, (25), 678; **51**, (1), 17).—E. refers to a paper by Hitchcock (*Met. Abs.*, this vol., p. 332), and asks for references concerning the effect of nickel on zinc-base die-casting alloys. H. replies, giving 6 references to the literature and 10 patent references.—H. W. G. H.

†**Constitution of Zinc–Tin Alloys.** E. A. Anderson and R. L. Wilcox (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1339).—A brief review of the literature, with a *bibliography* of 9 references. A diagram is given, based on the work of various investigators.—S. G.

Wrought Zinc and Zinc Alloys. E. H. Kelton (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1346–1348).—Discusses briefly rolled zinc, drawn rod and wire, mechanical properties, the fabrication of rolled zinc and zinc alloys, deep-drawing, &c. Various grades of wrought zinc are tabulated, with their compositions, characteristics, and suggested uses, and the mechanical properties of wrought zinc and zinc alloys are also tabulated.—S. G.

Developments in Non-Ferrous Alloys (Heavy Metals). D. K. Crampton (*Metal Progress*, 1937, **32**, (4), 569–574; and *Met. Ind.* (*Lond.*), 1937, **51**, (20), 475–477).—A review, giving references to casting and forging practice, including the production of strip and sheet by direct freezing between the rolls, to bright-annealing, powder metallurgy, and welding. New applications of copper, bimetallic materials, selenium, tellurium, silver-base, tin-base, and zinc-base alloys are briefly described.—P. R.

Bearing Metals and Their Testing. H. Mann (*Jahrb. Lilienthal-Ges. Luftfahrt.*, **1936**, 459–465).—The incidence of wear and friction within a bearing is discussed, and special developments in soft and hard bearing alloys for aircraft use are described. Special reference is made to the possibility of smearing action, and to the dynamic loading tests devised by the Deutsche Versuchsanstalt für Luftfahrt.—P. R.

***New Alloys with a High Coercive Force.** Werner Jellinghaus (*Z. tech. Physik*, 1936, **17**, (2), 33–36).—The development of high magnetic properties in Mishima magnet steels (containing nickel and aluminium) has been correlated with the formation of a superlattice structure and the effect reproduced in a series of binary alloys. The alloys of iron and palladium, iron and platinum, and also cobalt and platinum, each containing 50 atoms-% iron or cobalt, have a high coercive force after suitable heat-treatment; all three alloys form ordered solid solutions by transformation in the solid state. The cobalt–platinum alloy had a coercive force of 400 Oersteds and a remanence of 3900 gauss. Owing to the fact that the atoms have only to diffuse short distances, the superlattice state is much more readily developed than the normal age-hardened state. The high coercive power associated with these ordered solid solutions is probably due, not to intercrystalline strain, but to the mutual repulsion of unlike atoms.—C. E. R.

***Change of Properties Due to Heat-Treatment in Alloys That Have Varying Solubility in Solid Solution—Particularly a Theory on the Cause of Temper-Brittleness of Steels.—I, —II.** Kinji Yokoyama (*Nippon Kinzoku Gakkai-Shi* (*J. Jap. Inst. Metals*), 1937, **1**, (1), 43–58; (2), 92–103).—[In Japanese.] Temper-brittleness, and the analogous phenomenon in Duralumin, aluminium–copper alloys, 18 : 8 stainless steel, and Corson alloy, were studied, with reference to a new theory of the temper-brittleness of steels.—S. G.

†Theory of Inverse Segregation. Willi Claus (*Metallwirtschaft*, 1937, **16**, (37), 917–926).—Inverse segregation in alloys (displacement of the residual liquid during solidification towards the zone of primary solidification) is ascribed to the pressure set up by the liberation of gas from the residual liquid. Gravity, centrifugal force, and shrinkage effects can have only a directional effect on the phenomenon. In the case of alloys which solidify as solid solutions or by peritectic reactions, the magnitude of the inverse segregation effects is proportional to the solidification range. The fluidity of the residual liquid determines the magnitude of the effects in any individual alloy. Similar rules apply to eutectic alloys.—v. G.

Inverse Segregation: A Review. N. B. Vaughan (*J. Inst. Metals*, 1937, **61**, 35–57; discussion, 57–60).—The literature relating to inverse segregation is reviewed. The nature of the phenomenon is described, and a selection is given from the published experimental data to illustrate the influence of the various factors which have been found to affect the extent of inverse segregation. These factors include: composition of the alloy, casting temperature, pouring speed, mould material and temperature, and the relative size of ingot to mould. The papers from which the figures quoted have been chiefly taken are by Woronoff, Bohner, Claus and Goeke, and Genders. The numerous theories which have been advanced to account for inverse segregation are summarized, and the main supporting evidence is indicated. The principal theories are those of Smith (Le Chatelier's law), Benedicks (Ludwig–Soret effect), Masing (undercooling), Kühnel (contraction pressure of solidified shell), Bauer and Arndt (interdendritic flow), Masing and Haase (crystallization pressure), Genders (gas evolution), and Watson (dendrite migration). No attempt has been made, however, by the author to appraise the different theories. A *bibliography* of 84 references is appended.—N. B. V.

Technical Test for the Gas Content of Liquid Metal. W. A. Danilov (*Metallurg* (*Metallurgist*), 1937, (4), 134–136).—[In Russian.] Samples of heavy metals or alloys for the gas-content test are cast either in a mould or on an iron sheet; the latter is preferable for light metals. The results obtained with various copper and aluminium alloys are recorded.—N. A.

Diffusion in Solid Metals in Relation to Lattice Constants and Melting Temperatures. N. F. Lashko and B. U. Petrenko (*Zhurnal Fizicheskoy Khimii* (*J. Phys. Chem.*), 1936, **8**, (4), 597–599).—[In Russian.] The movement of diffusing particles is treated as a Brownian agitation. By combining the formulæ of Einstein and Fick, a relation can be established between the diffusion coeff. and the minimum distance of two atoms in the lattice. A relation between the diffusion coeff. and the melting temperature is deduced from Braune's statistical theory of diffusion.—N. A.

***Changes in the Crystal Structure of Metallic Solid Solutions and Their Effect on the Properties of These Alloys as Catalysts.** G. Rienäcker (*Metallwirtschaft*, 1937, **16**, (26), 633–634).—The rate of decomposition of formic acid on metal catalysts was determined. The energy of activation is greatest in the case of alloys with random atomic distribution; thus with the 25 atomic-% gold–copper alloy it is 12%, with the 20 atomic-% palladium–copper alloy 25%, with the 46 atomic-% palladium alloy 30%, and with the 63 atomic-% alloy 40% greater than when the atomic distribution is ordered.—v. G.

Influence of Supersonic Waves on Liquid [Metal] Phases. A. I. Shultin and P. M. Kornilov (*Sobshenia Zentralnogo Instituta Metallov* (*Comm. Centr. Inst. Metals*), 1936, (19), 131–144).—[In Russian.] An apparatus for producing supersonic waves is described. When metals and alloys with a low melting point (*e.g.* bismuth, 50 : 50 antimony–bismuth, 60 : 40 bismuth–cadmium, and 42 : 58 lead–bismuth alloys) are allowed to solidify under the influence of supersonic waves, the grain-size is reduced and the grains become equiaxed; such metal shows an increased plasticity.—A. R. P.

Acoustic Study of Metals. Tsutomu Kase (*Oyo Butsuri* (*Applied Physics*), 1937, 6, (3), 123–126).—[In Japanese.] It is suggested that the sound emitted by alloy specimens which have been dipped in liquid air is due to the friction between crystal grains occurring with $\gamma \longrightarrow \alpha$ transformation. —S. G.

***On the Application of Electrode Potentials to the Determination of the Critical Points of Metals and Alloys. [Nickel, Iron, Zinc, Thallium, Tin, and Certain Copper–Gold and Cadmium–Magnesium Alloys.]** M. Śmialowski (*Prace Zakładu Metalurgicznego Politechniki Warsawskiej*, 1934, 4, 100–139).—[In Polish, with French summary.] S. has measured, as a function of temperature, the e.m.f.'s of cells consisting of a silver rod as the positive pole, a mixture of salts as electrolyte, and a specimen of the metal to be investigated as the negative pole. The measurements were made on a quadrant electrometer at rates of heating and cooling from 1 to 10° C. per minute. The curves thus obtained showed much more definite changes in direction in the neighbourhood of the transformation points than would be expected from the Gibbs–Helmholtz equation, probably on account of temperature irregularities during the transformation. When the rates of change of temperature were large enough and the specimens sufficiently massive (*e.g.* 5 mm. in diameter and 100 mm. in length), the curves might exhibit two changes in direction, or even a maximum and a minimum in the neighbourhood of the transformation temperature. In the latter case the transformation (on heating) begins at the maximum in the curve and finishes at the third change in direction, the intervening minimum being probably due to a temperature difference between the specimen and the electrolyte caused by the absorption of the heat of transformation. The principal difficulties in the method lie in the choice of a suitable electrolyte and the avoidance of thermoelectric effects, though the latter are not of great importance, since these are small in comparison with those of solution. The best results were obtained in the case of electrolytic nickel, using as electrolyte a eutectic mixture of sodium and potassium acetates. The transformation point of nickel was thus found to be 360° ± 5° C., in agreement with the results of other methods. The results for iron were unsatisfactory. Pure electrolytic iron in an electrolyte of sodium and lithium sulphates showed critical points in the regions of 700° and 900° C., and steel with 0·85% carbon at 700°, 850°, and 900° C., the last being probably caused by decarburization of the steel during the experiment. Thallium showed a transformation at 225° ± 5° C., and a melting point about 300° C. Tin did not give concordant results. The curves for Kahlbaum's pure zinc, and the 98·7% metal showed changes in direction at 320 ± 10° C. and 330° ± 10° C., respectively. The 50 atomic-% copper–gold alloy showed a transformation point at 375°–380° C. The cadmium–magnesium alloys gave the following transformation points: 40 atomic-% magnesium, 198°–207° C.; 50%, 251° ± 2° C.; 60%, 193°–205° C.; 70%, 152°–160° C. The paper is prefaced by a theoretical and historical introduction, and contains valuable tables of references to the literature concerning the methods and transformations involved.—P. W. R.

***An Extension of Bethe's Theory of Order–Disorder Transitions in Metallic Alloys.** T. S. Chang (*Proc. Roy. Soc.*, 1937, [A], **161**, (907), 546–563).—The theory of Bethe (*Proc. Roy. Soc.*, 1934, [A], **145**, 699) is extended so as to include not only the interactions between an atom and its nearest neighbours, but also those with the next nearest neighbours. Calculations are made for the simple cubic and body-centred-cubic lattices. The conclusions regarding the energy changes and extra specific heat are in better agreement with experiment than the theory of Bethe, which considered only the interactions between nearest neighbours. The agreement is still not exact, presumably because the theory does not take into account the higher interactions, and the heat motions.—W. H.-R.

Theory of Phase Changes. L. Landau (*Zhurnal Eksperimentalnoy i Teoreticheskoy Fiziki* (*J. Exper. Theoret. Physics*), 1937, **7**, (1), 19–32).—[In Russian.] Theoretical. Deals with the problem of continuous phase transitions (*i.e.* transitions not involving a latent heat) from a general thermodynamical point of view.—N. A.

Construction of Diagrams of State of Multi-Component Systems. J. F. Afonskiy (*Metallurg* (*Metallurgist*), **1937**, (4), 49–54).—[In Russian.] The use of a regular polygon for the representation of the properties of polynary systems is proposed. In all regular polygons the sum of the distances of a point inside the polygon from all its sides (or their prolongations) is equal to $nR.\cos(\pi/n)$, where n is the number of sides and R the radius of the circumscribed circle. It is suggested that this sum be taken as 100%.—N. A.

III.—STRUCTURE

(Metallography; Macrography; Crystal Structure.)

(Continued from pp. 506–512.)

Preparation of Polycrystalline Metallic Surfaces. P. Jacquet (*Acad. Méditerranéenne; Symposium "La Corrosion par l'Eau de Mer,"* **1937**, 255–258).—It is pointed out that mechanically-polished metal surfaces are not crystalline but are amorphous (Beilby layer); surfaces prepared by J.'s electrolytic method are, however, crystalline, reproducing the characteristics of the metal.—A. R. P.

The Preparation and Microscopic Examination of Metallic Specimens. G. W. Pirk (*Wire and Wire Products*, 1936, **11**, (8), 378–382, 404; (9), 430–435, 462; (11), 648–654).—A detailed description of conventional methods of preparing, polishing, and etching metallographic specimens, with special reference to copper and ferrous alloys. Some examples of the use of microscopic examination in overcoming troubles in working operations are quoted. —J. C. C.

Polishing of Aluminium for Metallographic Examination. E. H. Dix, Jr., and F. Keller (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 980–981).—S. G.

Etching of Aluminium for Microscopic Examination. E. H. Dix, Jr., and F. Keller (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 982–986).—Etching for macroscopic and microscopic examination, and the identification of constituents are discussed, and useful tables are given for: (1) etching solutions; (2) etching characteristics of constituents; (3) identification of constituents in commercial alloys. A *bibliography* of 23 references is appended.—S. G.

New Etchant for 3S Aluminium [Aluminium–Manganese Alloys]. —— (*Min. and Met.*, 1936, **17**, (353), 261).—The manganese–aluminium alloy 3S may be etched by immersion for 4–5 seconds in a boiling 2% caustic soda solution containing 0·5 c.c. per litre of water-glass, rinsing in running water, and dipping for a few seconds in concentrated nitric acid.—A. R. P.

Polishing of Copper and Its Alloys for Microscopic Examination. C. H. Davis (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1114–1115).—S. G.

Etching of Copper and Its Alloys for Macroscopic and Microscopic Examination. C. H. Davis (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1116–1117).—A useful table of etching solutions is given.—S. G.

Preparation of Lead and Lead Alloys for Metallographic Examination. J. R. Vilella (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1183–1184).—S. G.

Etching Lead and Lead Alloys for Metallographic Examination. J. R. Vilella (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1185–1186).—S. G.

Polishing Nickel and Its Alloys for Metallographic Examination. E. M. Wise (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1272).—S. G.

Etching Solutions for Nickel and Nickel Alloys. W. A. Mudge (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1273–1274).—S. G.

Preparation and Etching of Tin and Tin Alloys for Metallographic Examination. C. H. Hack (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1318–1319).—S. G.

***The Influence of Difference of Orientation of Two Crystals [of Tin] on the Mechanical Effect of Their Boundary.** (Chalmers.)—See p. 586.

New Methods for Investigating the Crystallization of Metals and Alloys. L. R. Edelson (*Metallurg* (*Metallurgist*), **1937**, (4), 142–146).—[In Russian.] Describes apparatus for the investigation of metals and alloys in the state of vibration and rotation, and for the separation of the solid from the liquid phase by filtration and centrifuging.—N. A.

Crystallization and Structure of [Zinc] Ingots. V. O. Gagen-Torn (*Metallurg* (*Metallurgist*), **1937**, (2), 3–20).—[In Russian.] From a review of the literature, observations made in the foundry, and the results obtained in original work on ingots of pure zinc, it is concluded that: (*a*) Tammann's crystallization laws apply only to substances with a complex structure and a low rate of crystallization (organic compounds, silicates, &c.), and not to metals, except when the mass is extremely small, or during the short period at the beginning of crystallization when the fine-grained surface layer is being formed in contact with the mould walls; (*b*) the spontaneous formation of nuclei in a body of liquid metal is impossible; (*c*) the ordinary crystallization process in liquid metals starts from pre-existing nuclei which are generally small crystals of the metal itself; (*d*) ingot structure is determined by the rate and direction of heat exchange and by the length of time during which growth of isolated crystals, mainly near the top of the ingot, is possible; and (*e*) the rate of crystallization is determined by the rate of cooling, and not by the degree of undercooling, and is limited by the " natural rate of growth," which, in metals, is determined by the heat conductivity, although under industrial conditions other factors play some part.—N. A.

Direction of Grain-Growth in the Recrystallization of Zinc Single Crystals. M. Karpova (*Zhurnal Eksperimentalnoy i Teoreticheskoy Fiziki* (*J. Exper. Theoret. Physics*), **1937**, 7, (2), 305–311).—[In Russian.] The recrystallization centres in deformed single crystals of zinc originate at the boundary between the original crystal and the twin. If the angle χ between the long axis of the crystal and the basal plane is small, the new grain grows into the twin only, but if the temperature exceeds 400° C., the grains begin to grow outside the twin as well. If a crystal in which χ is small is stretched in liquid air, the lattice remains completely undeformed.—N. A.

Micrography and Electron Diffraction. G. I. Finch. A. W. Hothersall. D. J. Macnaughtan (*Met. Ind.* (*Lond.*), 1937, **50**, (18), 510; (19), 537).—F. suggests an experiment to compare the electron diffraction and micrographic methods of examining electrodeposits, and offers to supply nickel-plated copper discs, one half to be examined by him, and the other to be submitted to microscopical examination. H. and M. accept F.'s challenge. H. considers that samples of copper deposited on copper would be preferable to nickel-plated copper.—H. W. G. H.

Physical Methods in Metallurgy. II.—Electron Diffraction. Bruce Chalmers (*Met. Ind.* (*Lond.*), 1937, **50**, (24), 645–648).—The properties of electrons and the phenomenon of electron diffraction are described, and explained. The Finch type of camera is described, and its application to the examination of polished surfaces, oxide films, and electrodeposited coatings is discussed. A selected *bibliography* of 21 references is given.—H. W. G. H.

***Electron Diffraction and the Structure of Polished Surfaces [below the Amorphous Layer].** Charles Stephen Lees (*Abstracts Dissertations Univ. Cambridge*, **1936–37**, 122–123).—Careful consideration and experiments have led to an accurate method of taking electron-diffraction pictures. After the removal of known thicknesses from the polished surfaces of copper and gold by electrolysis, there is found a " comparatively thick layer of oriented crystals (110 direction normal to the surface)." This is stated to be due to " compression of the crystals, probably by rolling grains of the polishing agent."
—A. G. D.

The Nature of Polished Metal Surfaces. F. Gräser (*Oberflächentechnik*, 1937, **14**, (17), 173–174).—A discussion of modern views on the subject.—A. P.

The Study of Wear and Lubrication by Electron Diffraction. G. I. Finch and F. D. Zahoorbux (*Inst. Mech. Eng. General Discuss. on Lubricants, Advance Copy*, **1937**, (Group IV), 100–106).—The application of electron-diffraction phenomena to the investigation of metallic surfaces is outlined, and particular attention is paid to bearing surfaces in this respect. Photographs illustrate some typical patterns.—R. Gr.

Direct Observation of Structural Changes at High Temperatures with the Aid of the Electron Microscope. Wilhelm Gerard Burgers (*Z. Metallkunde*, 1937, **29**, (8), 250–251).—Essentially a German translation of a previously published article. See *Met. Abs.*, this vol., p. 296.—A. R. P.

Crystals and the Crystal Structure of Metallic Compounds. C. G. James (*Assoc. Eng. Ship. Draughtsmen*, **1937**, 84 pp.).—After a short section on physical crystallography an elementary exposition is given of the crystalline structure of metals. The possible constituents of steels are described with illustrations, while methods and apparatus for the metallographical and photomicrographical examination of metal specimens are dealt with at length. The concluding section briefly reviews the history, elementary theory, and applications of the X-ray investigation of crystals, with descriptions of common apparatus.—G. V. R.

The Structure of Beryllium. G. F. Kosolapov and A. K. Trapeznikov (*Zhurnal Eksperimentalnoy i Teoreticheskoy Fiziki* (*J. Exper. Theoret. Physics*), 1936, **6**, (10), 1163–1175).—[In Russian.] X-ray powder-diagrams of beryllium : (*a*) annealed *in vacuo* at 600° C. and quenched, and (*b*) annealed in air at 900° C., show additional lines, not due to beryllium or its oxide. The positions of these lines and their relative intensities indicate that they may be due to a β-modification of the metal, although the possibility of their being due to impurities is not excluded.—N. A.

***Transition from Hexagonal to Cubic Electrodeposited Chromium.** W. A. Wood (*Phil. Mag.*, 1937, [vii], **24**, (161), 511–518).—Strips of copper were plated with hexagonal cobalt, using a chromic–sulphuric bath containing sugar as a reducing agent to ensure a preponderance of the chromous ions. On heating the strips to increasing temperatures, the first appearance of the cubic modification was noted at 98° C. Between 98° and 129° C. the proportion of the cubic form rapidly increased, and at 129° C. the transition was entirely complete after heating for 15 minutes. With specimens heated for 1 hr.

there was no narrowing of the range of temperature over which the transition to the cubic form took place; there was, thus, no sudden transition, but an extended transformation over about 30° C. The grain-size decreased during the transformation from the hexagonal to the cubic form, and this effect was studied by measurements of the widths of X-ray diffraction rings. The grain-size of the cubic product of transformation formed by heating the hexagonal material is of the same order as that of the cubic material deposited directly, and the softening effect of any hexagonal constituent of a deposit may be effectively removed by heat-treatment.—W. H.-R.

***On Some New Ternary Compounds with a Superstructure of the β-Brass Type.** P. Rahlfs (*Metallwirtschaft*, 1937, 16, (26), 640–644).—The following four compounds have a cubic face-centred lattice: $Cu_3Ni_3Sn_2$, $a = 5{\cdot}946$ A.; $Cu_3Ni_3Sb_2$, $a = 5{\cdot}857$ A.; Ni_2MgSn, $a = 6{\cdot}097$ A.; Ni_2MgSb, $a = 6{\cdot}050$ A. The lattice structure can also be interpreted as body-centred cubic with superstructure of the β-brass type and with parameters of half the above values.—v. G.

***Crystal Structure of Gallium Nitride.** G. S. Shdanov and G. V. Lirman (*Zhurnal Eksperimentalnoy i Teoreticheskoy Fiziki* (*J. Exper. Theoret. Physics*), 1936, 6, (10), 1201).—[In Russian.] GaN has a hexagonal lattice of the wurtzite type, $a = 3{\cdot}160 \pm 0{\cdot}008$ A., $c/a = 1{\cdot}622$.—N. A.

***X-Ray Investigations on Lead Alloys.** Wilhelm Hofmann (*Z. Metallkunde*, 1937, 29, (8), 266–267).—The changes in structure produced by rolling and recrystallization can be followed in lead and lead alloy foils by means of X-rays; they are almost identical with those which occur in aluminium under similar conditions. X-ray examination has confirmed the fact that age-hardening, followed by cold-rolling of hard lead alloys, retards recrystallization.—A. R. P.

***Constitution of Phosphides, Arsenides, Antimonides, and Bismuthides of Lithium, Sodium, and Potassium.** G. Brauer and E. Zintl (*Z. physikal. Chem.*, 1937, 37, (5/6), 323–352).—The following compounds have a hexagonal lattice, in which the metalloid atom fills the gaps in the hexagonal packing of the alkali metal atoms; the unit cell contains two molecules: α-Li_3Sb, $a = 4{\cdot}201$, $c = 8{\cdot}309$ A., $c/a = 1{\cdot}768$; Li_3As, $a = 4{\cdot}387$, $c = 7{\cdot}810$ A., $c/a = 1{\cdot}780$; Li_3P, $a = 4{\cdot}264$, $c = 7{\cdot}579$ A., $c/a = 1{\cdot}777$; Na_3Bi, $a = 5{\cdot}448$, $c = 9{\cdot}655$ A., $c/a = 1{\cdot}772$; Na_3Sb, $a = 5{\cdot}355$, $c = 9{\cdot}496$ A., $c/a = 1{\cdot}773$; Na_3As, $a = 5{\cdot}088$, $c = 8{\cdot}982$ A., $c/a = 1{\cdot}765$; Na_3P, $a = 4{\cdot}980$, $c = 8{\cdot}797$ A., $c/a = 1{\cdot}767$; K_3Bi, $a = 6{\cdot}178$, $c = 10{\cdot}933$ A., $c/a = 1{\cdot}770$; K_3Sb, $a = 6{\cdot}025$, $c = 10{\cdot}693$ A., $c/a = 1{\cdot}775$; K_3As, $a = 5{\cdot}782$, $c = 10{\cdot}222$ A., $c/a = 1{\cdot}768$. Li_3Sb can also exist in a cubic β-form, $a = 5{\cdot}559$ A., 4 molecules in the unit cell. The preparation of the compounds, in some cases a difficult operation, is described in detail.—v. G.

***The Structure of Zirconium Silicide, $ZrSi_2$.** St. v. Náray-Szabó (*Z. Krist.*, 1937, 97, (3), 223–228).—[In German.] The structure of the compound $ZrSi_2$ has been deduced from the experimental data of Seyfarth (*ibid.*, 1928, 67, 294). The structure is orthorhombic, and the sides of the unit cell are $a = 3{\cdot}72$ A., $b = 14{\cdot}61$ A., $c = 3{\cdot}67$ A. The space group is $D_{2h}^{17} - Cmcm$ with 4 molecules in the unit cell. All atoms lie on digonal axes in layers 0, y, $\frac{1}{4}$, &c. The parameters of the zirconium atoms are $y = 0{\cdot}106$, whilst the silicon atoms fall into two groups, for which the parameters are $y' = 0{\cdot}750$ and $y'' = 0{\cdot}355$, respectively. The structure is a layer structure in which each layer contains both silicon and zirconium atoms. Each zirconium atom has one and two zirconium neighbours at distances 3·60 and 3·72 A., respectively, and eight silicon neighbours at distances from 2·66 to 2·83 A. Each silicon atom has two silicon neighbours at 2·38 A., two at 2·40 A., and four at 2·66 A., and also four zirconium neighbours at the distances given above.—W. H.-R.

***On the Atomic Forces of Solid State.** Weng Wen-Po (*Phil. Mag.*, 1937, [vii], 24, (161), 466–472).—Cf. *Met. Abs.*, 1936, 3, 532, and this vol., p. 95. The theory is extended to non-metallic substances including silicon.—W. H.-R.

***The Effect of Discontinuities of the Background on the Evaluation of the Intensities of X-Ray Reflections from Crystalline Powders.** A. Baxter and J. C. M. Brentano (*Phil. Mag.*, 1937, [vii], 24, (161), 473–491).—The causes of the discontinuous character of the background of white radiations on powder photographs are discussed in detail. Where accurate intensity measurements are required, considerable errors may be introduced by these effects, and methods for their elimination are described.—W. H.-R.

The Elements of a Theory of the Determination of the Orientation of Single Crystals from a Rotational X-Ray Diagram. E. J. Sovz (*Zhurnal Eksperimentalnoy i Teoreticheskoy Fiziki* (*J. Exper. Theoret. Physics*), 1937, 7, (2), 293–303).—[In Russian.] The sensitivity of the method, and the influence of experimental errors, are discussed.—N. A.

Absorption Factor for the Rotating-Crystal Method of Crystal Analysis. Otis P. Hendershot (*Rev. Sci. Instruments*, 1937, [N.S.], 8, (9), 324–326).—S. G.

IV.—CORROSION

(Continued from pp. 512–517.)

***Researches on the Behaviour of Aluminium Towards Fruit Products.** G. Reif and H. J. Steinbeck (*Aluminium*, 1937, 19, (7), 450–452).—The rate of corrosion of aluminium (99·5 and 99·8%, rolled and unannealed, unprotected and protected by Eloxal and M.B.V. films), Pantal, Mangal, and B.S.S. alloy in contact with cherry jam, apple pulp, and plum pulp for 4–6 months was determined. The Eloxal-treated sheets behaved by far the best, being practically unattacked by the jam, and only slightly attacked by the pulps. Annealed sheets of unprotected aluminium behaved better than hard-rolled sheets, and the 99·8% metal better than the 99·5%. All the alloys were inferior to the lowest-grade aluminium. The losses in weight of the metals in the pulps were 20–30 times as great as in the jam, probably owing to the much higher water content (40–70%) of these as compared with the jam (26%).—A. R. P.

***Chromate Additions as Means of Limiting the Attack of Phosphoric Acid on Aluminium.** H. Röhrig and K. Geier (*Aluminium*, 1937, 19, (7), 448–450).—The rate of dissolution of 99·45% aluminium in phosphoric acid solutions at 20° C. increases from 5·6 grm./m.^{2}/day in 1% acid to 189·6 grm./m.^{2}/day in 88% acid; addition of 0·1% of sodium chromate reduces these rates to 0·07 and 171·5 grm./m.^{2}/day, respectively. With addition of 1·5% of sodium chromate, the amount of aluminium dissolved in 14 days at 20° C. is 0·06 grm. with 1% acid, 0·5 grm. with 5% acid, 5 grm. with 10% acid, 12·9 grm. with 20% acid, and 28·6 grm./m.^{2} with 88% acid. At 95° C. in 20% phosphoric acid, 56·4 grm./m.^{2} of aluminium is dissolved in 10 minutes; this amount is rapidly reduced on addition of chromate, until with 5% of sodium chromate only 0·1 grm./m.^{2} of metal is dissolved. Under similar conditions, cast Silumin undergoes loss in weight of 1·3 grm./m^2. The importance of these results for cleaning scale from aluminium ware used in the milk industry is discussed.—A. R. P.

***Stability of Aluminium Against Drilling Oil Emulsions.** Werner Geller (*Aluminium*, 1937, 19, (10), 639–640).—The thick commercial emulsions used as lubricants in drilling aluminium are diluted with water before use, and, since the presence of lime has a deleterious effect on the soap used as emulsifier, hard waters are usually softened by addition of sodium carbonate before use; if an excess of this alkali is used in softening the water serious corrosion of the metal may ensue, but this may be prevented by addition of a small amount of water-glass. If 0·5% of acetic acid is used instead of sodium carbonate there is very little corrosion of the metal.—A. R. P.

***Action of Coke-Oven Gases on Aluminium.** Werner Helling (*Aluminium*, 1937, 19, (10), 646–647).—To examine the possibility of using aluminium or its alloys for making the overhead rails for the cranes dumping coal into the ovens or the resulting coke into the quenching towers, specimens of aluminium and Pantal sheets, unprotected and protected by Eloxal or M.B.V. films, were suspended over the ovens and over the towers for 1 year. In the first case, the metal became encrusted with a soot and tar film beneath which the oxide film was intact and only a small amount of local pitting had taken place, while in the second case more general corrosion had occurred, but the results seemed to indicate that a halt would take place in the progress of corrosion after more or less exposure to the steam (containing sulphur dioxide) evolved on quenching the coke.—A. R. P.

***Effect of Salt Spray on Aluminium Alloys Under Simultaneous Static Stress.** R. Irmann and W. Müller (*Schweiz. Arch. angew. Wiss. Tech.*, 1937, 3, (6), 158–166).—A new apparatus is described. The effect of static tensile stress on the corrosion of sheets and wires was studied, and the effect of corrosion was measured by loss in tensile strength. The alloys investigated included those containing aluminium–copper–magnesium (Avional), aluminium–magnesium–silicon (Anticorodal and Aldrey), aluminium–magnesium (Peraluminium 7).
—W. A. C. N.

†Aluminium Bronzes for Corrosion Service. H. J. Miller (*Metal Treatment*, 1937, 3, (11), 131–137, 154).—Both the α-group of aluminium bronzes, containing aluminium up to 8% (and sometimes nickel up to 4%) and the duplex group containing aluminium from 8 to 11% with, frequently, additions of iron, manganese, and nickel, are widely used for their corrosion-resisting properties. Only with alkalies which dissolve the oxide films are they less corrosion-resistant than copper. Data on the resistance of these alloys to the atmosphere, sea-water, solutions of sodium hydroxide, mineral acids, and the reagents used in paper-pulp plant, and to their attack by gases at high temperatures, are reviewed. A *bibliography* of 23 references is appended.—J. C. C.

***Investigation of Corrosion-Resistant Alloys for Radiator Tubes.** A. E. Gopius (*Zvetnye Metally* (*Non-Ferrous Metals*), 1937, (1), 88–93).—[In Russian.] The materials studied were: copper; 68 : 32 brass; aluminium bronzes with 1·88, 3·2, 4·19, and 5·38% aluminium; 80 : 20 brass in which 0·94, 1·84, and 2·97% aluminium, or 2·98% aluminium, 3·0% silicon, and 0·83% manganese, replaced the corresponding amount of copper; and 5 : 5 : 90 aluminium–nickel–copper alloy. Radiator tubes of these materials were tested for corrosion: (*a*) in water at 60° C., (*b*) in moist air, and (*c*) in sea-water (intermittent immersion). The tendency of the tubes to crack after various methods of annealing was also studied. Aluminium increases the resistance to corrosion by hot water. Silicon–manganese–bronze is stable in hot water. The weight and appearance of all the tubes remained unchanged after exposure to moist air for 3 months. The aluminium–brasses showed the best resistance to sea-water. Silicon–manganese bronze and pure copper had the least tendency to crack on annealing. Increasing the aluminium content of the bronzes increased their tendency to crack. This effect was still more marked in the brasses.—N. A.

***Studies in the Corrosion Problem of Condenser Tubes.—V.** Tomojiro Tanabe, Goro Koiso, and Masuo Yata (*Sumitomo Kinzoku Kōgyō Kenkyu Hōkoku* (*Res. Rep. Sumitomo Metal Ind., Ltd.*), 1937, 2, (11), 1199–1210).—[In Japanese.] Cf. *Met. Abs.*, 1936, 3, 536, 669; this vol., p. 341. Two series of Albrac tubes, one made by the vertical-extrusion process and the other by the S.-P. (solid-piercing) process, were studied for their resistance to sea-water in the model condenser previously referred to. It is concluded that the differences in methods of manufacture do not affect the corrosion-resistance of the alloy. Extruded Albrac products, however, have been shown to be the more suitable for expanding and bell-mouthing, the extrusion process being more efficient than the S.-P. process. Tungum and Broternal tubes were also studied. The resistance of Tungum to corrosion and erosion was found to be very poor, and it is therefore not suitable for condenser tubes. The Broternal tubes had a very good erosion-resistance, although de-aluminization and pitting took place on some of them. Some jet tests were made on plain copper–aluminium alloys, and interesting results were obtained.—S. G.

Theory of Passivity Phenomena. XXX.—Anodic Passivity Phenomena of Magnesium in Acid Solutions. W. J. Müller and E. Nachtigall (*Monatsh.*, 1936, 69, (1/2), 1–10).—When magnesium is anodically polarized as a shielded electrode in dilutes ulphuric acid, it becomes passive and is then covered with an almost black film. This film also develops if the metal is anodically polarized in magnesium sulphate solution, or in dilute hydrochloric acid, but in these cases no passivity is produced. Magnesium may be passivated in nitric acid, but the phenomenon is complicated by side reactions.—A. R. P.

***The Corrosion of Magnesium Alloys. III.—Magnesium Alloys Containing Manganese or Silicon.** Hikozô Endô and Susumu Morioka (*Sci. Rep. Tôhoku Imp. Univ.*, 1937, [ii], 26, (2), 167–181).—[In English.] A study was made of the corrosion of several series of magnesium alloys: (*a*) with manganese, in the cast and annealed states; and (*b*) with silicon, in the cast state. The results show that the alloys of the systems magnesium–manganese, magnesium–zinc–manganese, magnesium–tin–manganese, magnesium–zinc–silicon, and magnesium–zinc–aluminium–manganese all have a high corrosion-resistance in the ranges: manganese $> 2\%$ for specimens as cast; manganese $> 0{\cdot}6\%$ for specimens annealed at 470° C.; zinc 2–6, manganese 0·6–2%; tin 2–8, manganese 0·5–2%; zinc 2–6, silicon 0·05–0·8%; and zinc 4, aluminium 6, manganese $> 1\%$, respectively, and that annealing at 470° C. is generally very harmful, except for the binary magnesium–manganese alloys, for which it is very effective in reducing the rate of corrosion.—S. G.

Nickel and Corrosion. —— Grard (*Rev. Nickel*, 1937, 8, (4), 98–104).—The electrochemical properties of nickel are reviewed, and the conditions influencing passivity are discussed. The influence of nickel on the corrodibility of a number of non-ferrous and ferrous alloys is described. A summarized account of the programme of corrosion tests sanctioned by the French Aeronautical Corrosion Committee is given: the superiority of certain nickel alloys is demonstrated by the resulting classification of corrosion-resistant alloys.
P. R.

***Dissolution of "Vacuum Films" in Acids. II.—Dissolution of Iron and Nickel in Sulphuric Acid.** M. A. Rosenberg and K. E. Avaliani (*Dokladi Akademii Nauk S.S.R.*, 1936, 4, (4), 171–172 (in Russian); and *Compt. rend. (Doklady) Acad. Sci. U.R.S.S.*, 1936, [N.S.], 4, (4), 179–180 (in German)).—See also *Met. Abs.*, 1936, 3, 668. Iron and nickel films obtained by cathode sputtering *in vacuo* dissolve readily in dilute sulphuric acid whether treated without exposure to air or after exposure for 1 hr. The nickel films dissolve more slowly than the iron films, and unlike these are not attacked by acid more dilute than about $0{\cdot}5N$.—N. A.

***On the Resistance to Acids of Alloys with an Iron–Nickel Base.** M. Schmidt and L. Wetternik (*Korrosion u. Metallschutz*, 1937, 13, (6), 184–189).—The rate of corrosion of alloys of iron with 18–60% nickel, with and without additions of molybdenum or copper or both, was determined in 1 : 9 and 1 : 4 hydrochloric acid, and in 1 : 4 sulphuric acid; the results are shown in tables and graphs. In the plain ferro-nickels good resistance to corrosion is obtained with more than 35% nickel in sulphuric acid, and with 60% nickel in hydrochloric acid. Addition of 2% molybdenum to all the alloys reduces the rate of corrosion in hydrochloric acid to very low values, but increases very considerably the rate of dissolution in sulphuric acid, especially with the lower nickel contents; further addition of molybdenum has no effect as regards hydrochloric acid attack, but with 10% molybdenum in the 60% nickel alloy, 13% molybdenum in the 35% nickel alloy, and 20% molybdenum in the 28% nickel alloy almost complete immunity to sulphuric acid is obtained. Addition of copper to ferro-nickel improves the resistance to hydrochloric acid appreciably, but reduces the resistance to sulphuric acid; addition of 2·5% copper to molybdenum-ferro-nickels entirely prevents the deleterious effect of the molybdenum on the resistance to sulphuric acid; in fact these alloys may be considered practically insoluble in this acid.—A. R. P.

Zinc Gutters Destroyed by Stray Currents. R. Priel (*Illust. Zeit. Blechindustrie*, 1937, **66**, (38), 1079).—A short illustrated account is given of damage to the zinc gutter pipes of a tramway depôt by stray currents, and of the measures subsequently taken to prevent future attack.—P. R.

"White Rust" Formation on Galvanized Wire. E. H. Schulz (*Wire Ind.*, 1937, **4**, (44), 447, 449).—From *Stahl u. Eisen*, 1930, **50**, (12), 360–362; see *Met. Abs.* (*J. Inst. Metals*), 1932, **50**, 609.—W. E. A.

Corrosion of Zinc-Coated Pieces. L. Lindsberg (*Russko-Germanskiy Vestnick Nauki i Tehniki* (*Deut.-russ. Z. Wiss. Tech.*), 1936, (10), 3–4).—[In Russian.] A review.—N. A.

On Alloys Resistant to Hydrochloric Acid. Masayoshi Tagaya (*Kikai Kogaku* (*Mech. Eng.*), 1937, **5**, (7), 2–14; and *Kinzoku* (*J. Metals*), 1937, **7**, (7/8), 403–414; 453).—[In Japanese.] A comprehensive review of the resistance of metals and alloys to hot and cold hydrochloric acid.—S. G.

Progress Report. Joint Committee on Exposure Tests of Plated Coatings on Non-Ferrous Metals. William Blum (*Monthly Rev. Amer. Electroplaters' Soc.*, 1937, **24**, (11), 815–818; and *Proc. Amer. Electroplaters' Soc.*, **1937**, 5–7).—The results obtained to date indicate that chromium coatings without a nickel undercoat afford very little protection, that on all base metals the protective value increases with the thickness of the nickel undercoat, that thin nickel coatings are more effective on copper and copper alloys than on zinc or steel, and that a thin grease film retards corrosion of plated articles and facilitates cleaning.—A. R. P.

Life of Non-Ferrous Screen Wire Cloth. —— (*U.S. Nat. Bur. Stand., Tech. Information Build. Mat.*, 1936, (2), 2 pp.).—Abstract of *Nat. Bur. Stand. Research Paper* No. **803**, 1935, by G. Willard Quick; see *Met. Abs.*, 1935, **2**, 429.—P. R.

Corrosion-Resistance of Welded Joints. A Review of the Literature to January 1, 1937. W. Spraragen and G. E. Claussen (*Weld. J.* (*J. Amer. Weld. Soc.*), 1937, **16**, (8), Suppt., 1–44; and (summary without bibliography) *Aluminium and Non-Ferrous Rev.*, 1937, **2**, (10), 357–360).—A comprehensive review of the literature comprised in 408 references, including a condensed summary of 3 pages. Both review and summary are non-critical, but most ably set forth so as to present, in the former, the opinions of original investigators, and, in the latter, the consensus of opinion. The non-ferrous materials dealt with are: aluminium and its alloys; copper and its alloys; nickel and its alloys; magnesium; zinc; lead; bronze-welded, soldered, and silver-soldered joints; and also clad materials.—H. W. G. H.

***Corrosion Tests of Metals and Alloys in Spray Mixtures.** E. M. Diffenbach (*Agric. Eng.*, 1937, **18**, 301–302; *C. Abs.*, 1937, **31**, 7385).—Samples of metals were immersed for 6 days in agitated solutions of 3 : 4 : 50 Bordeaux mixture (I), and 1 vol. of lime-sulphur (32° Bé.) in 50 volumes of water (II). Aluminium (whether 99% pure or containing 4% copper), nickel, nickel alloys, and stainless irons and steels were fully resistant to both solutions. Pure zinc and galvanized iron were not resistant to I, but were fairly resistant to II. Pure copper, copper alloys, pure tin, and a copper-bearing iron were resistant to I, but not to II. A copper alloy containing copper 74, nickel 20, and zinc 6% was fully resistant to II, but one containing copper 96, silicon 3, and manganese 1% was not resistant. Brass and bronze with copper content up to 85% were fairly resistant to both solutions. A bronze containing 95% copper was not resistant to II. Ordinary steel spray-gun discs were not resistant to either solution. Bordeaux mixture deposits on the test-specimens were best removed by rinsing for 30 seconds in 10% AcOH at room temperature, and then in water. Lime–sulphur deposits were removed by rinsing for 30 seconds in CS_2 under water, and then in benzine.—S. G.

Extreme-Pressure Lubricants and Lubrication [Corrosiveness of Oils]. F. L. Miller (*Inst. Mech. Eng. General Discuss. on Lubricants, Advance Copy*, **1937**, (Group III), 102–112).—Lead in the form of soap is widely used either alone, or in combination with sulphur and chlorine, as a basis of extreme-pressure lubricants. The results of tests on these lubricants are given. Active lead–sulphur lubricants are known as " powerful extreme-pressure lubricants." The " copper strip " corrosion test, wherein the lubricant may stain or blacken a polished copper surface, is stated to be misleading as a test of corrosiveness of oils, and bears no relation to service performance.—R. Gr.

Corrosion of Non-Ferrous Metals Underground. —— (*U.S. Nat. Bur. Stand., Tech. Information Build. Mat.*, 1937, (50), 2 pp.).—A summary is given of *Nat. Bur. Stand. Research Paper* No. **945**, 1937, by K. H. Logan; see *Met. Abs.*, this vol., p. 194.—P. R.

Submerged Corrosion of Ferrous Metals. —— (*U.S. Nat. Bur. Stand., Tech. Information Build. Mat.*, 1936, (22), 5 pp.).—An extensive series of tests on the liability of ferrous metals to soil corrosion included certain ferrous samples coated with zinc, lead, and other metals. Conclusions regarding these have not yet been reached.—P. R.

International Consultative Committee on Telephony (C.C.I.F.)—11th Plenary Assembly, Copenhagen, 11–20 June, 1936. —— (*J. Télécommunications*, 1936, **3**, (7), 185–193).—Section II B reviews the discussions on corrosion and the conclusions reached on the protective value of electrical drainage, direct and graduated, and of insulated joints. The details and conditions of application of these are described. See *Met. Abs.*, 1936, **3**, 546.
—R. T.

Corrosion of Metals Used in House Construction. —— (*U.S. Nat. Bur. Stand., Tech. Information Build. Mat.*, 1936, (1), 3 pp.; (10), 3 pp.; (17), 4 pp.).—The causes and incidence of certain types of corrosion are reviewed in relation to house construction, and the limitations of accelerated corrosion tests are indicated. Atmospheric conditions influencing corrosion are discussed in connection with exposure tests on ferrous materials. The protective properties of zinc, lead, tin, and " terne " (lead–tin) coatings for ferrous sheet are compared, and a description is given of exposure tests on galvanized sheet in marine, industrial, rural, and tropical sea-coast atmospheres. The average life of coatings of different thicknesses is indicated in each case, and recommendations are made regarding the painting of galvanized sheet for use in the various atmospheres considered.—P. R.

Locomotive Feed-Water Treatment. J. S. Hancock (*J. Inst. Locomotive Eng.*, 1937, 27, (136), 198–221; discussion, 221–255).—Illustrations of pitting, grooving, and corrosion of steel tubes in locomotive boilers are included in this account of methods of feed-water treatment employed by the L.M.S. Railway Co., Ltd. By using the " Churchward " top-feed apparatus, which ensures that oxygen is almost completely liberated in the steam space, corrosion of tubes is considerably reduced.—J. C. C.

[Discussion on the] Cavitation Research at Massachusetts Institute of Technology [and on] Progress of Cavitation Research at Princeton University. —— (*Trans. Amer. Soc. Mech. Eng.*, 1936, 58, 315–321).—Discussion on papers by Hunsaker (*Met. Abs.*, 1936, 3, 543) and by Moody and Sorenson.—S. G.

On the Corrosion of Metals in Sea-Water. The Function of the Couple Active Metal–Passive Metal in Sea-Water. G. Chaudron (*Acad. Méditerranéenne : Symposium* "*La Corrosion par l'Eau de Mer,*" 1937, 277–284).—The effects of differential aeration, temperature changes, film formation, and presence of impurities in the metal in determining the course of corrosion in sea-water are discussed in the light of recent work. The presence of magnesium salts (which polarize the elements of the couple) and of bicarbonates (which act as a buffer) in natural sea-water tends to retard corrosion.—A. R. P.

***Protective Properties of the Corrosion Products of Different Metals.** V. V. Skortcheletti and B. V. Idelchik (*Sobshenia Zentralnoyo Instituta Metalov* (*Comm. Central Inst. Metals*), 1936, (19), 179–196).—[In Russian.] A study was made of the rate of corrosion of iron, copper, cadmium, zinc, and aluminium in sodium chloride and sodium sulphate solutions. The rate of penetration of the ions through the films of corrosion products, the sensitivity of the films to non-uniform aeration, the interfacial resistance between electrolyte, film, and metal, the conductivity of the loose corrosion products and their capacity for adsorbing Cl' and SO_4'' ions were investigated. Low penetration rates and high interfacial resistance of the film are essential for low rates of corrosion of aluminium, copper, and, to a smaller degree, cadmium. Irregular aeration is of minor importance in the cases of aluminium in sulphate and copper in chloride solutions, but, although zinc shows little sensitivity to non-uniform aeration in sulphate solutions, it is rapidly corroded by them. The adsorptive capacity of the corrosion films does not appreciably affect the rates of corrosion of the metals. A high interfacial resistance is ascribed to the presence of an adherent corrosion film below the exterior spongy film.—N. A.

On the Theory of Corrosion Phenomena Caused by Oxygen Depolarization. F. Tödt. G. W. Akimov and H. Clark (*Korrosion u. Metallschutz*, 1937, 13, (4/5), 157–162).—Polemical; T. claims that the results obtained by A. and his co-workers are identical with those previously published in a series of papers by T. between 1928 and 1936. In reply A. and C. point out certain new facts brought out by their work and discuss their bearing on the theory of the process.—A. R. P.

†The Rôle of Oxygen in Corrosion. U. R. Evans (*Métaux et Corrosion*, 1937, 12, (137), 5–6).—The "probability" of corrosion diminishes with the concentration of oxygen, but the "velocity of reaction" increases. Examples of these stimulating and inhibiting actions are given. The intense attack at the liquid–gas level is often attributed to the presence of oxygen at this place, but it can also occur if the gas is hydrogen. Further, in certain cases, the well-aerated zone can remain unattacked, owing to the differential aeration currents between the aerated (cathodic) and the non-aerated (anodic) zones. The rate of corrosion of underground conductors is often greater when the ground is damp but contains air-pockets; the differential aeration currents are very important in this case. 15 *references* are given.—J. H. W.

***An Investigation of Differential Aeration as a Factor in the Localization of Corrosion.** G. D. Bengough and F. Wormwell (*J. Soc. Chem. Ind.*, 1937, 56, (10), 349–362T).—Experiments, chiefly on mild steel, to determine the effects of differential aeration in determining the course of corrosion are recorded in detail; the results support B. and W.'s film theory of corrosion distribution, according to which certain areas on a metal surface remain immune from corrosion when the film-forming factors locally predominate over those promoting corrosion, and neighbouring areas corrode owing to the relative preponderance of corrosive over film-forming factors. Corrosion in nearly neutral solutions is favoured by a high rate of oxygen supply, temperature fluctuations, the presence of anions yielding soluble anodic products or substances in solution which prevent precipitation of films on the metal, a strongly basic electrode potential, and a low hydrogen overvoltage; corrosive action is depressed by the presence of substances either in the solution or metal which favour the formation of protective films, a high oxygen concentration continuously maintained, the presence of factors in solution which cause certain corrosion products to take a form hindering anodic action, and the absence of impurities in the metal. Non-uniformity of corrosion and, in extreme cases, local pitting are produced by inhomogeneity of the electrolyte during corrosion, the surface condition of the metal and other factors causing potential differences, gravitational streaming, interfacial tension effects, film breakdown, differential aeration, and the presence of foreign bodies.—A. R. P.

Modern Ideas of Corrosion and Corrosion Passivity. W. J. Müller (*Oesterr. Chem.-Zeit.*, 1937, 40, 236–239).—A review of M.'s theories of the phenomena of corrosion and passivity.—A. R. P.

***Theory of the Electrochemical Poly-electrode Systems and Their Application to Corrosion Problems. I.—Potentials of Binary Systems.** G. W. Akimov and N. D. Tomaschov (*Korrosion u. Metallschutz*, 1937, 13, (4/5), 114–123).—From measurements of the potentials of copper–cadmium, copper–zinc, copper–lead, and copper–iron couples in various electrolytes, it is shown that the total potential of a galvanic couple and, in some cases, the potential of a heterogeneous binary alloy are intermediate between the values for the two constituents and not, as is commonly asserted, equal to that of the more negative constituent, the actual value depending on the ratio between the resistances of the anode and cathode element. Expressions for the dependence of the total potential (V) on this ratio are deduced and analyzed. When the point of contact of the comparison electrode in the electrolyte is a considerable distance from the system compared with the distance between the two elements (*e.g.* in the case when the system is a heterogeneous alloy), V depends on the ratio between the anode and cathode surfaces; expressions for the relation between V and this ratio are also deduced and analyzed. The effect of polarization is such that the closeness of V to the potential of the more negative constituent depends only on the closeness of the potential of the polarized cathode to the anode potential, an effect which is often observed in short-circuited elements. Reduction of the polarization of the active cathode makes V more positive.—A. R. P.

An Electrochemical Study of the Corrosion of Metals. J. B. Chloupek and V. Z. Danes (*Korrosion u. Metallschutz*, 1937, 13, (4/5), 124–127).—An apparatus is described in which the potential of a metal plate in one compartment is measured against that of a silver cathode in a second compartment of the cell under standard or carefully controlled conditions. From the values obtained during the progress of corrosion of different metals, conclusions can be reached as to their relative resistance to corrosion. The results obtained with copper, α-brass, and bronze in 5% sodium chloride solution are tabulated. The values for bronze were much lower than for copper and decreased with time of exposure, indicating that copper was being leached out of the surface layer; at the end of the test the metal was coated with a white tin-rich film. —A. R. P.

***On the Application of Potential Measurements in the Study of the Behaviour of Metals in Corrosive Media.** L. Guitton (*Korrosion u. Metallschutz*, 1937, 13, (4/5), 131–157).—The potentials of good commercial grades of tin, zinc, nickel, copper, aluminium, lead, iron, and stainless steel were determined in dilute and concentrated sulphuric, hydrochloric, and nitric acids after various periods of immersion; the amount of metal dissolved in mg./cm.^{2} was also determined for periods up to 48 hrs., and an attempt is made to correlate the data obtained from both series of tests in a series of graphs. The dissolution potential–amount dissolved in 48 hr. curves so obtained are the more irregular the more oxidizing is the acid. In non-oxidizing acids (hydrochloric or dilute sulphuric acid) the values obtained for the different metals fall on a smooth curve irrespective of the time of immersion and the nature of the solvent; this relation holds good for oxidizing acids only when the time of immersion is relatively short. Certain electronegative metals, *e.g.* aluminium, exhibit an "abnormal partial passivity" in non-oxidizing acids, and others show an "abnormal activity" in oxidizing acids (*e.g.* copper in nitric acid). From these results it is proposed to classify metals into three groups: (1) completely non-oxidizable metals, *e.g.* platinum, gold; (2) metals which have a negative potential in the active state but which become "non-oxidizable by passivation," *e.g.* tin, lead, aluminium; (3) non-resistant metals with a negative potential. There are many exceptions to this classification, of which the following, *inter alia*, are discussed: (*a*) lead is only slightly soluble in dilute hydrochloric acid; this is ascribed to the relatively insoluble chloride formed since, in concentrated acid which dissolves the chloride film, attack is rapid; (*b*) aluminium is partially passivated in concentrated hydrochloric acid, but dissolves readily in more dilute acid; this is due to the insolubility of $AlCl_3,6H_2O$ in the concentrated acid or possibly to the formation of an insoluble oxychloride film; (*c*) tin dissolves only slowly in dilute hydrochloric acid, but rapidly in concentrated acid; no satisfactory explanation of this anomaly has yet been advanced; (*d*) the insolubility of lead sulphate is the cause of the slow corrosion of lead in sulphuric acid; (*e*) the various behaviours of nickel, aluminium, and copper in nitric acid of *d* 1·025, 1·33, and 1·49 are described at some length and satisfactory explanations are advanced.—A. R. P.

***On the Theory of Corrosion Phenomena. V.—On the Relation Between the Establishment of a Potential, Corrosion, and Corrosion Passivity of Metals in Aqueous Solutions.** W. J. Müller (*Korrosion u. Metallschutz*, 1937, 13, (4/5), 144–157).—Recent work on the rate of dissolution of metals in very dilute iodine solutions is held to afford strong confirmation of the correctness of the electrochemical theory of dissolution of metals, according to which local elements are set up which produce the dissolution. The application of this theory to the corrosion of metals in aqueous media in the absence of air or oxidizing agents explains the establishment of a potential, $e' = E_M + \frac{E_S - E_M}{w_p + w_s} . w_p$ (where E_M is the potential of the metal, E_S is the overvoltage of the hydrogen ions of the local cathode, w_p and w_s are the resistances in and outside the pores of the coating film) when the metal is immersed in the solution. In this case $i_L = (E_S - E_M)/(w_p + w_s)$ (i_L is the local current) and corrosion depends entirely on the properties of the coating film. The changes in the corrosion rates with time can, as is shown in the case of aluminium, be directly correlated with changes in w_p and w_s, and therefore with E_M and E_S. For corrosion in the presence of oxygen or oxidation agents the corrosion equation is $i_L = (E_S - E_M)/(w_p + w_s) + nFDQC_o/\delta'$, where C_o is the concentration of oxidizing agent, D its diffusion coefficient, F is Faraday's constant, Q is the area of the cathodic areas, and δ' the thickness of the diffusion layer. The magnitude of w_p depends chiefly on the stability of the oxidized protective layer in the particular corroding medium; if this is stable, coating passivity is induced by which the size of the pores shrinks to 10^{-4} cm.^{2}/cm.^{2} so that the local currents can no longer produce corrosion, but if the pores accumulate in definite areas, such as grain boundaries, no self-passivation occurs, and normal dissolution of the metal can take place along these boundaries (intercrystalline corrosion). The theory is further discussed with reference to the rusting of iron under various conditions.—A. R. P.

Corrosion Tests in Professor Palmaer's Laboratory. N. Goldowski (*Métaux et Corrosion*, 1937, **12**, (139), 58–62).—The work on the study of the corrosion of ferrous metals, the conductivity of electrolytes, and on overvoltage in the five laboratories of the Académie des Sciences is described.—J. H. W.

***The Measurement of the Damping and Resonance as an Aid in Corrosion Research.** Armin Schneider and Fritz Förster (*Z. Metallkunde*, 1937, **29**, (9), 287–292).—The work of Förster and Köster (*Met. Abs.*, this vol., 427) has been extended to an investigation of the corrosion of an 11% magnesium–aluminium alloy in acid 3% salt solution after various heat-treatments. Local surface corrosion has no effect on the damping, but immediately intercrystalline corrosion sets in the damping shows a marked increase and the curve shows quantitatively the progress of corrosion. Quantitative conclusions on the progress not only of intercrystalline corrosion, but also of surface corrosion, can be reached from the resonance curves obtained at various stages during exposure of the metal to corrosive conditions. Intercrystalline corrosion sets in rapidly, when the alloy is annealed at 150°–300° C. for 3 hrs., but after annealing at 375° C. the alloy remains immune to this type of corrosion for more than 30 hrs. The effect of annealing in accelerating corrosion is much more marked when the alloy is previously quenched from 450° C. than when it is air-cooled. Cold-working accelerates intercrystalline corrosion in quenched alloys, but not in air-cooled alloys. The results obtained in resonance and damping tests have been confirmed by physical tests, chemical tests, and micrographic examination.—A. R. P.

***On a New Method for Corrosion Testing.** Jean Cournot and Marcel Chaussain (*Rev. Mét.*, 1937, **34**, (8), 475–477).—Specimens are totally immersed in the corroding medium and the latter is permitted to evaporate slowly until eventually no portion of the specimen is in contact with the liquid. Results of tests of aluminium, Duralumin, Armco iron, and annealed steel are given, in comparison with those of immersion tests of the alternate wet and dry, total immersion near surface, and deep total-immersion types. Loss of weight is taken as a measure of the corrosion. The new test gives greater loss by corrosion than the other tests and appears likely to be a useful one, but is not considered suitable for general use or standardization.—H. S.

***The Use of the Thyssen–Bourdouxhe Apparatus for the Estimation of Corrosion by Solution.** Paul Bastien (*Métaux et Corrosion*, 1937, **12**, (138), 32–35).—An apparatus for measuring the rate of corrosion, *i.e.* the rate of loss of weight per unit surface, must: (1) use a sufficient volume of the reagent for the variation of concentration during the test to be negligible, (2) work at a constant temperature different from the surrounding temperature, (3) circulate the reagent sufficiently to eliminate the effect of the products of corrosion. A description is given of the Thyssen–Bourdouxhe apparatus which fulfils these conditions very simply. It can be applied to a large variety of corrosion investigations, such as the corrosion of ultra-light alloys, comparison of the corrosion-resistance of industrial and very pure brands of certain metals, the decomposition of aluminium–magnesium solid solutions, and the application of microchemical analysis. 6 *references* are given.—J. H. W.

***Standardization of Salt-Spray Tests.** Jacques Pomey (*Métaux et Corrosion*, 1937, **12**, (139), 47–51).—The possibility of accelerating salt-spray tests has been considered by the Commission de Corrosion des Produits Métallurgiques pour l'Aéronautique. It is recommended: (1) that the temperature should not appreciably exceed 35° C., (2) that the composition of synthetic sea-water should be distilled water 1000 c.c., pure sodium chloride 30 grm., pure magnesium chloride 3 grm., sodium bicarbonate 0·2 grm., having a p_H of 7·7, (3) that the composition of the atmosphere should be adjusted according to the amount of bicarbonate in the saline solution, an addition of pure carbon dioxide of the order of 0·5 litre/hour being required. An example of standard apparatus giving satisfactory results is given.—J. H. W.

***The Use of Colour Photography for Recording the Results of Exposure Tests.** C. A. Vincent-Daviss and W. Blum (*Monthly Rev., Amer. Electroplaters' Soc.*, 1937, **24**, (11), 818–821; discussion, 821–822; and *Proc. Amer. Electroplaters' Soc.*, **1937**, 8–9; discussion, 10).—Colour photographs taken on Dufay films afford a satisfactory permanent record of the colour and appearance of defects observable by the eye, *e.g.* cracks, blisters, tarnish, peeling, and local pitting; in photographing mirror-bright finishes, however, the colour of any surrounding objects reflected in them tends to mar the record.—A. R. P.

***Coloroscopic Detection of Corrosion with p_H Indicators.** N. Goldowski (*Korrosion u. Metallschutz*, 1937, **13**, (4/5), 128–131).—The indicator is made by dissolving the following reagents in 1 l. of alcohol: cresolphthalein 1·5, phenolphthalein 5, methyl red 4, bromomethyl blue 4, naphthophthalein 3·2, and methyl orange 1 grm.; this gives a red colour at p_H 3, orange at p_H 5, yellow at p_H 6, green at p_H 8, greenish-blue at p_H 9, and violet at p_H 11. The corroding medium used is 1% sodium chloride containing 10% of gelatin and 1% of the above indicator, neutralized with sodium hydroxide until it is of a yellowish-green colour (p_H about 8); this solution is saturated with oxygen before use and then sprayed in a lukewarm condition on the metal or alloy to be tested. As the resulting film hardens, the protected cathodic areas become violet-coloured while the active anodic areas become red. Once a stable colouring is obtained the specimen can be stored for a year if access of moisture is prevented. Examples of the use of the method in examining Duralumin for corrosion-resistance are briefly described.—A. R. P.

New Photomicrographic Apparatus for Corrosion-Testing. A. Kufferath (*Korrosion u. Metallschutz*, 1937, **13**, (6), 189–191).—An illustrated description of a new micrographic outfit adapted to take kinematographic pictures of the course of corrosion.—A. R. P.

Corrosion of Metals. A. Leroy (*Rev. Soud. Autogène*, 1937, **29**, (283), 226–234).—See *Met. Abs.*, this vol., p. 516.—H. W. G. H.

The Fight Against Corrosion in the Netherlands. G. Batta (*Métaux et Corrosion*, 1937, **12**, (138), 35–39).—The organization of research on corrosion recently set up in Belgium and the work that it is carrying out are summarized.—J. H. W.

V.—PROTECTION

(Continued from pp. 517–523.)

***Corrosion Protection of Aluminium by Additions to the Corrosive Medium.** H. Lichtenberg (*Aluminium*, 1937, **19**, (8), 504–509).—Passivation of aluminium in acid solutions may be produced by additions of small amounts of colloids or various organic substances such as nicotine sulphate, or dibenzyl sulphide; a similar effect is produced in alkaline solutions by additions of water-glass or of organic dyestuffs. The protective action of many of these substances has been measured in various media and the results are tabulated and briefly discussed.—A. R. P.

***Beitrag zur Technik der anodischen Oxydation von Aluminium unter besonderer Berücksichtigung des Alumilite-Verfahrens.** (Walter.) See p. 709.

***Simple Method for Determining the Thickness of Eloxal Films [on Aluminium].** F. Loepelmann (*Metallwirtschaft*, 1937, **16**, (31), 777–778).—The film is removed by treating the metal with 5% sodium hydroxide solution containing about 1% of zinc (as zincate), and the thickness of the sheet is measured before and after this treatment; the difference is the thickness of the film, or double the thickness if both sides are coated. As soon as the film is removed, the metal becomes black by deposition of zinc.—v. G.

***On the Depth of Penetration of Electrolytes Used in the Anodic Oxidation of Aluminium.** H. Röhrig (*Aluminium*, 1937, **19**, (9), 585–586, (10), 649). The throwing power of Eloxal electrolytes has been tested under various conditions with particular reference to the thickness of the films formed in deep and narrow apertures. Good throwing power is obtained with both the sulphuric and oxalic acid baths when d.c. or a combination of d.c. and a.c. is used; with a breadth : depth ratio of 1 : 60 of the aperture the film at the bottom is 3 μ thick in the first case and 1·5 μ thick in the second when that at the top is 12–16 μ thick.—A. R. P.

The Use of Eloxal in the Reconstruction of the Reichskreditgesellschaft in Berlin. A. Kleine (*Aluminium*, 1937, **19**, (9), 606–612).—Aluminium alloys are used for all the decorative metal work, for doors, window frames, balustrades, &c.—A. R. P.

The Electrolytic Oxidation of Aluminium in the Patent Literature. Kurt Nischk and Fritz Markhoff (*Oberflächentechnik*, 1937, **14**, (15), 153–158).—See *Met. Abs.*, this vol., p. 150.—A. R. P.

Electrolytic and Chemical Surface-Treatment of Light Metals. —— (*Werkstatt u. Betrieb*, 1937, **70**, (21/22), 295–297).—An account is given of the treatment of aluminium and its alloys by the Eloxal process, with notes on subsequent "sealing" treatment and on the limits of composition over which the method is applicable. An analogous treatment of magnesium (Elomag process) is shortly described. Brief reviews are given of the M.B.V. and Jirotka processes and of the dichromate-pickling of Elektron.—P. R.

Permanent Surface Protection for Aluminium. D. C. Mandeville (*Metallurgist* (Suppt. to *Engineer*), 1937, **11**, 58–61).—A brief review of anodizing processes and their uses.—R. G.

The Storage of Light Metals. A. Jaeschke (*Illust. Zeit. Blechindustrie*, 1937, **66**, (32), 911–913; and *Werkstatt u. Betrieb*, 1937, **70**, (21/22), 281–282).—Storage accommodation for light alloys must provide protection against mechanical injury and corrosive attack. Methods of storing materials of varying form and composition are indicated, a system of identification markings is proposed, and a summary is given of rapid chemical tests for unmarked material.—P. R.

Protection of Magnesium Against Corrosion. John A. Gann (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1231–1234).—Discusses cleaning, chemical treatment, painting, baked finishes, and assembly protection. A paint schedule is given for magnesium alloys.—S. G.

The Use of Aluminium for the Protection of Iron Against Corrosion. L. Lindsberg (*Russko-Germanskiy Vestnick Nauki i Tehniki* (*Deut.-russ. Z. Wiss. Tech.*), **1936**, (8), 3–6).—[In Russian.] A description of the technical methods of coating iron with aluminium by immersion, and of the properties of iron sheets protected in this way.—N. A.

Roofing Tin (Terneplate) for House Construction. —— (*U.S. Nat. Bur. Stand., Tech. Information Build. Mat.*, 1936, (41), 3 pp.).—Terneplate (steel sheet coated by dipping in a bath of approx. composition lead 75, tin 25%) is recommended for use on flat roofs; its properties are compared with those of ordinary galvanized sheet, and commercial requirements are summarized. A tabulated summary gives the weight of base metal and coating, and the permissible variations in the weight of the finished product, for 2 common grades of terneplate.—P. R.

†The Methods of Testing Zinc Coatings. L. Kenworthy (*J. Inst. Metals*, 1937, **61**, 143–161; discussion, 161–169).—The measurement of the protective value of zinc coatings on iron and steel, other than by accelerated-corrosion tests, is carried out by examination of certain properties of the coating, namely, average weight, uniformity, structure, and porosity. Under these four headings, the various methods which are in use or which have been proposed for carrying out this type of determination are described, together with their respective advantages, limitations, and in certain cases suggested modifications. Methods for determining average weight mostly depend on direct weighing of the sample before and after the coating has been removed. Other methods make use of the heat developed or the gas evolved during the dissolution of the coating in acid. In the recently developed electrolytic test (Britton's test) the time taken to remove the coating with a known current density is used. Chemical methods of dissolution, depending on a time factor for the determination of thickness, are not applicable to coatings partially or entirely composed of alloy layer, because of variation in the rate of dissolution with composition. They may be suitable, however, for the measurement of uniformity, as is the case with the copper sulphate (Preece) test. The electrolytic test, on the other hand, removes the same weight of coating per unit time irrespective of composition. Structure is preferably determined by metallographic examination, whilst the weight of the component layers of the coating may be measured by the electrolytic test using potential measurements. Several proposed tests for porosity are described, although this property does not assume for zinc coatings the same importance as for coatings electropositive to iron. The requirements of zinc coatings to withstand corrosion vary with the conditions of exposure, and whilst for atmospheric attack the life is almost entirely dependent on the total weight of the coating (including alloy layer), for immersed conditions there is evidence that the composition of the coating plays an important part. The particular advantages of certain methods for evaluating the various requirements for both types of conditions are discussed. A *bibliography* of 54 references is given.—L. K.

New Methods for the Analytical Determination of Tin, Lead, Copper, Brass, and Zinc in Coatings on Iron. A. Vollmer (*Oberflächentechnik*, 1937, **14**, (16), 163–164).—Results are given of tests made with certain solvents (nature not stated) which dissolve coating metals from iron or steel without attacking the basis metal. Intermediate alloy layers, *e.g.* iron–tin or iron–zinc compounds, are not dissolved so the method can be used for determining the amount of these present in hot-dipped coatings.—A. R. P.

***A Magnetic Tester for the Thickness of Plating, Galvanizing, &c., on Iron Articles.** C. E. Richards (*J. Soc. Chem. Ind.*, 1937, **56**, (9), 343–346T).—The construction of an electromagnet coupled with a spring balance for measuring the thickness of plated, galvanized, or painted coatings on iron by determining the magnetic pull is described and some results obtained by its use are recorded. The method gives results with an accuracy of ± 0·5 mil on galvanized or cadmium-plated coatings 2–5 mils thick; it cannot be used for thinner coatings or for nickel coatings. The great advantages of the method are that it is non-destructive, can be used on large articles, and can be used for determining the uniformity of the coating since only a small area is tested.—A. R. P.

***Contribution to the Study of the Formation of Hot-Dipped Zinc Coatings [on Steel].** H. Bablik (*Korrosion u. Metallschutz*, 1937, **13**, (7/8), 248–254).—When a piece of clean mild steel is kept in molten zinc at 450° C. for some time, three alloy layers can be distinguished on the surface: (A) containing 10% iron and consisting of minute crystals next to the iron surface; (B) containing 7·5% iron and consisting of long crystals perpendicular to the iron surface having the appearance of a palisade; and (C) consisting of larger more irregular crystals (just below the outermost pure zinc layer) containing about 6·2% iron. The thickness of the various layers increases with the time of immersion as follows: (A) in 4 minutes is 15 μ, in 30 minutes 20 μ, in 240 minutes 50 μ, and in 480 minutes 60 μ thick; the corresponding values for (*B*) are 13, 38, 125, and 190 μ; and for (*C*) 15, 30, 60, and 60 μ. Layer (*A*) seems to consist entirely of $FeZn_7$; there is no evidence at all of the formation of $FeZn_3$ or of Fe_5Zn_{21}. Crystals which form at the sides and bottom of the galvanizing pot after prolonged use contain 5–6% iron and appear to be identical with (*C*); if the zinc bath contains a small addition of aluminium the crystals formed at the bottom are larger, hexagonal, and contain 7·3% iron. The (*B*) layer seems to be produced only under conditions where pressure can be exerted on the alloy layer; it never forms at sharp corners, on the outside of bent sheets, or on wires. When the 5·7% iron–zinc alloy is prepared by melting the constituents together it forms a compact mass of *d* 5·5, but after annealing in hydrogen for 3½ hrs. at 430° it becomes very porous and brittle and the apparent *d* falls to 4·4. The brittleness of some galvanized coatings is attributed to the presence of the (*B*) layer since during the "galvannealing" process, which renders the coating much more pliable, the (*B*) layer entirely disappears and the whole coating is converted into (*A*). When the galvanizing operation is carried out at 485° C. or higher, only the (*A*) layer is formed and this is covered with a layer of small disconnected crystals of an iron–zinc alloy irregularly embedded in iron-saturated zinc if the time of immersion is sufficiently prolonged. At 550° C. a thin (*A*) layer is covered with a thick irregular layer of (*B*), but no (*C*) layer is formed; the (*A*) layer still contains 10·3% iron, but the crystals deposited at the bottom of the pot contain 9·3% iron and appear to consist of (*B*). Numerous photographs of characteristic structures produced under various conditions are included, and a theory of the formation of the various layers based on diffusion phenomena is advanced.—A. R. P.

***On the Thickness of the Coating, Its Pliability, and the Formation of Spangles on Hot-Dipped Galvanized [Iron] Sheet.** H. Grubitsch and F. Bruckner (*Korrosion u. Metallschutz*, 1937, **13**, (7/8), 254–260).—Curves are given showing the effect of temperatures between 440° and 550° C. and time of immersion between 10 and 120 seconds on the thickness of the zinc alloy and total coating and on its pliability; mild-steel sheets and 98·1% zinc (containing lead 1·2 and tin 0·3%) were used in the tests. The structure of the coating depends on the temperature of the galvanizing bath; up to 490° C. a thick protective alloy coating is formed on the steel, but between 490° and 520° C. this coating breaks up into a mass of loosely adherent crystals, many of which float off into the zinc bath. At higher temperatures the alloy coating again becomes compact and adherent. The composition of the bath or, within limits, of the steel and the time of immersion (up to 2 minutes) have no influence on the nature of the coating. The thickness of the coating produced at 440°–480° C. increases rapidly with increase in temperature but constant time of immersion; with constant temperature the thickness of the coating as well as that of the outer zinc layer increases in proportion to the square root of the time of immersion. The thickness-temperature curves show a well-marked maximum at 480° C. and a second (smaller) maximum at 500° C., with a sharp, well-defined minimum at 490° C.; the curves rise steeply to 480° C., and fall just as steeply above 500° C. The reciprocal of the pliability increases rapidly with increase in time of immersion and with increase in temperature of the bath. The lustre of the coating and the size of the spangles are strongly dependent on the time and temperature of galvanizing; the best coatings are obtained at 490°–500° C. in 10 seconds, at 480°–490° C. in 30 seconds, at 450°–460° C. in 60 seconds, and at 440° C. in 2 minutes. If these optimum conditions are exceeded, the surface of the coating becomes lustreless and rough and the coating itself is made up of small crystals.—A. R. P.

Adhesion of Galvanized Coatings on Steel Wire. Ernest H. Lyons, Jr. (*Wire and Wire Products*, 1936, **11**, (11), 655–656, 674).—Complete removal of oxides and other impurities from the surface of iron wire is essential for the production of satisfactory electro-zinc coatings. Brilliant, ductile zinc coatings are now produced by depositing at 1500 amp./ft.^{2}, after suitable cleaning operations.—J. C. C.

A New Galvanizing Furnace. W. H. Spowers (*Wire and Wire Products*, 1936, **11**, (6), 286, 293, 300–301).—See *Met. Abs.*, 1936, **3**, 461.—S. G.

Historical Data Relating to Hot-Galvanizing Practice for Wire. J. L. Schueler (*Wire and Wire Products*, 1936, **11**, (8), 383–385, 403).—The development of hot-galvanizing from about 1838 up to the introduction of the "galvannealing," Crapo, and "Flame Seal" processes is briefly outlined.—J. C. C.

"Black" and Galvanized Sheets for Use in House Construction. —— (*U.S. Nat. Bur. Stand., Tech. Information Build. Mat.*, 1936, (42), 5 pp.).—The quality and classification of "black" (plain steel) sheet is discussed, and reference is made to *U.S. Nat. Bur. Stand. Tech. Information Bull.* No. **17**, which summarizes the advantages of protection by galvanizing. The A.S.T.M. classification of galvanized sheet is quoted, the characteristic appearance of satisfactory material is summarized, and reference is made to U.S. and to Bureau of Standards specifications.—P. R.

On Rust Protection.—II, —III. H. Roters (*Mitt. Forschungsinst. Edelmetalle*, 1937, **10**, (12), 119–128; **11**, (4/5), 27–35).—A review of recent work and patents dealing with galvanizing, lead-coating, hot-dip tinning, coating with cadmium and aluminium by hot-dipping, sprayed coatings and plated coatings of zinc, tin, cadmium, chromium, and copper on iron, and their value as protection against rusting.—A. R. P.

†**Protection by Metallic Coatings. A Progress Report.** A. Kutzelnigg (*Korrosion u. Metallschutz*, 1937, **13**, (7/8), 221–241).—Recent progress in protecting metals from corrosion by applying coatings of other metals is critically surveyed. The following subjects are discussed: cladding, sprayed coatings, sherardizing, cemented coatings, immersion coatings, plated coatings, adhesion of the coatings, applications of coated metals in industry, testing of coatings. A *bibliography* of 289 references is appended.—A. R. P.

Protection Against Corrosion Obtained by Metallic Coatings. Société Nouvelle de Métallisation (*Acad. Méditerranéenne: Symposium "La Corrosion par l'Eau de Mer,"* **1937**, 267–269).—Steel wires coated with aluminium and zinc by various methods were subjected to a series of physical and chemical actions designed to imitate the destructive effect of industrial atmospheres; the zinc deposits have so far proved to be superior to the aluminium, the sherardized coatings giving the best protection.—A. R. P.

***Cementation of Tungsten, Molybdenum, Vanadium, and Tantalum on Nickel.** Tsutomu Kase (*Japan Nickel Rev.*, 1937, **5**, (4), 583–590).—[In English and Japanese.] A summary, with tables of data, from a series of papers by K. in Japanese in *Kinzoku no Kenkyu*, 1937, **14**, (1), 22–34; (2), 75–86; (4), 120–129; (4), 130–137; see *Met. Abs.*, this vol., pp. 151, 247, and 397.—S. G.

Metal Spraying (with Special Reference to Adhesion). E. C. Rollason (*Metal Treatment*, 1937, **3**, (11), 118–125, 130).—The main features of wire, molten-metal, and powder-spray pistols are described, and the character of sprayed metal coatings is discussed. Particles projected from wire-fed pistols become oxidized only after they have reached the sprayed surface when the article is near the pistol. The porosity of the coatings varies with the spraying distance. Reference is made to methods of measuring adhesion which, since it occurs by mechanical interlocking, is largely influenced by the nature of the surface. Methods of abrasive-blasting with angular flint sand or steel grit, which should precede spraying, are described, and the effects of abrasive flow-rate, type of nozzles, and angle of projection on the blasting efficiency considered. Some applications of metal spraying are described.—J. C. C.

Metal Spraying. B. Granowski (*Modern Eng.*, 1937, 11, (7), 393–395).—For protection against corrosion, zinc, cadmium, lead, and tin are used; for ornamental work, bronze is sprayed on to steel work and grilles, &c.; coatings of aluminium are used to increase the resistance of fire-bars, &c., subject to heat; and worn parts are reclaimed by building-up with sprayed steel, Monel metal, nickel, stainless steel, or bronze.—H. W. G. H.

***Results of Tests [on Sprayed Metal Coatings].** —— (*Métalliseur*, **1937**, (10), 5–12).—See also *Met. Abs.*, this vol., p. 521. Continuation of the Report from the Laboratoire du Comité des Recherches et Expériences Techniques des Peintures & Vernis. Test-pieces were metal-sprayed with various coatings, and the results are given for test-pieces Nos. 10–25. Excellent protection was given by the samples sprayed with zinc wire and afterwards treated in various ways, and also by the majority of the coatings sprayed with extra-pure aluminium or with a coating of cadmium applied by the wire process. One sample sprayed with zinc by the powder process and a Sherardized coating were also very good. Spraying with extra-pure aluminium by the wire process and then giving some after-treatment did not give such good results, and still less satisfactory results were obtained from a zinc coating sprayed with special powder, and with the zinc coating afterwards sprayed with glass. Very poor protection was given by spraying stainless steel, lead wire, or cadmium powder. The final conclusion is that sprayed zinc offers a very good protection to steel under the conditions of test, and that the best results are obtained from coatings by the wire process.—W. E. B.

The Painting of Light and Heavy Metals. O. Th. Koritnig (*Korrosion u. Metallschutz*, 1937, 13, (9), 307–315).—Methods of preparing the metal surface, the application of suitable protective paints and varnishes, and methods of accelerating the drying and hardening of the film are discussed.—A. R. P.

The Protection of Light Metals by Painting. B. Scheifele (*Korrosion u. Metallschutz*, 1937, 13, (9), 317–319).—The use of various paints and pigmented varnishes and lacquers with natural or synthetic resinous bases is briefly discussed.—A. R. P.

Aluminium Paints. —— (*U.S. Nat. Bur. Stand., Tech. Information Build. Mat.*, 1937, (43), 6 pp.).—Mainly a digest of a paper by P. H. Walker and E. F. Hickson (*J. Inst. Metals*, 1925, 33, 376). The results of exposure tests on aluminium and red-lead paints of stated composition are tabulated. Compositions are indicated for aluminium paints: (*a*) of good brushing consistency, (*b*) for application to vertical surfaces. References are given to the relevant U.S. standard specifications for vehicles and driers, and recommendations are made regarding the preservation of leafing properties, for paints for outdoor and indoor use, and for mixtures to withstand exposure to heat and to sulphide fumes.—P. R.

The Lacquering of Light Metals. —— (*Werkstatt u. Betrieb*, 1937, **70**, (21/22), 300–301).—The lacquering of aluminium has assumed considerable importance in Germany in connection with the replacement of tin by aluminium or light alloys. Special difficulties were experienced in the lacquering of light-alloy collapsible tubes. Suitable lacquers for various base materials, types and sizes of work, and surface finishes are recommended. In the case of light alloys adhesion is improved by a preliminary anodic treatment.—P. R.

VI.—ELECTRODEPOSITION

(Continued from pp. 523–528.)

Cadmium Plating in the Precision Industry. A. M. Sokov (*Tochnaja Industria* (*Präzisions Ind.*), **1936**, (8/9), 19–20).—[In Russian.] A review.
—N. A.

Hard Chromium Plating and Its Applications. K. Gebauer (*Korrosion u. Metallschutz*, 1937, **19**, (7/8), 269–274).—Hard chromium plate is produced by the use of high current densities (40–50 amp./dm.^{2}), high plating temperatures (50°–60° C.), and special baths (nature not stated); strongly adherent films 1–40 μ thick, having a Rockwell C hardness of 65, are deposited on iron and steel articles subject to hard wear, provided the surface is first roughened by anodic etching. The hardness is due not to adsorbed hydrogen but to the presence of certain inclusions and to a distortion of the body-centred cubic structure of the deposited metal. The hydrogen is removed by heating the deposit at 250°–300° C. without affecting the hardness, but at 500° C. softening begins. Deposits made on a soft basis metal resist wear by sliding friction, but a hard basis metal is necessary for wear-resistance under rolling friction. Resistance to corrosion depends on the porosity of the deposit; coatings 0·03–0·04 mm. thick are generally sufficiently non-porous to protect steel in the salt-spray test for 150 hrs. Various commercial applications of hard chromium plating are discussed.—A. R. P.

On the Theory of Electrolytic Chromium Plating.—III. Robert Weiner (*Z. Elektrochem.*, 1937, **43**, (10), 808–812).—Polemical against E. Müller (*Met. Abs.*, this vol., p. 448). W. rejects M.'s conclusions on a number of grounds, including M.'s assumption that anions as well as cations are deposited at the electrode during chromium plating.—L. E. P.

Some Questions on Cyanide Copper Plating. Frank J. Kohlmeier (*Proc. Amer. Electroplaters' Soc.*, **1937**, 196–204; discussion, 204).—From practical experience with a number of commercial cyanide copper-plating baths, a large number of problems for future research are suggested.—A. R. P.

Electrodeposition of Copper and Zinc from Chloride Solutions. S. A. Pletneva and V. N. Pozov (*Zhurnal Prikladnoĭ Khimii* (*J. Applied Chem.*), 1936, **9**, (9), 1568–1579).—[In Russian.] To obtain satisfactory results in the production of electrolytic copper from solutions of cuprous and sodium chlorides, the copper concentration must be not less than 17–18 grm./litre, and the current density not higher than 200–250 amp./m.^{2}; efficient circulation of the electrolyte is essential. Copper cannot be deposited directly from solutions of cupric chloride, since the first effect of the current is to reduce this to cuprous salt. The cuprous chloride electrolyte can be used for direct refining of cement copper without the use of a diaphragm. The apparatus required is, however, so complicated that no practical use of this method can yet be contemplated. Good deposits of zinc can be obtained from a solution of zinc chloride, with a current yield of up to 90%, when the zinc concentration exceeds 40 grm./litre and the current density 400 amp./m.^{2}. The free acid present should be about 10 grm. of HCl/litre, and the electrolyte must be rapidly circulated. Asbestos diaphragms can be used in the zinc electrolyses.—N. A.

***The Effect of Superimposing Alternating Current on the Electrodeposition of Copper and Zinc.** V. I. Skirstimonskaia (*Zhurnal Prikladnoĭ Khimii* (*J. Applied Chem.*), 1937, **10**, (4), 617–623).—[In Russian.] With a superimposed a.c. in the electrodeposition of copper and zinc the cathodic polarization and current yield are reduced. If the densities of the two currents are so chosen as to give a pulsating d.c., the nature of the copper deposited is not essentially affected, but the zinc deposit has a larger grain-size than that obtained by d.c. alone. If the density of the a.c. is such that the potential is continually reversed, the copper deposits become darker and contain oxygen, whereas the zinc deposits become finer grained and more porous, owing to enlargement of the co-deposited hydrogen bubbles.—N. A.

***Gallium. Part III.—The Electrodeposition, Purification, and Dissolution of Gallium.** F. Sebba and W. Pugh (*J. Chem. Soc.*, **1937**, 1373–1376).—Conditions for the electrodeposition of quantities of the order of 10 grm. of gallium were determined. The metal contained traces of lead, tin, and platinum, which were removed by washing with hydrochloric and nitric acids. The behaviour of the metal towards certain acids was also studied.—S. V. W.

Gold Electroplating. Paul Oldam (*Proc. Amer. Electroplaters' Soc.*, **1937**, 137–140; discussion, 140–142; and *Monthly Rev. Amer. Electroplaters' Soc.*, 1937, **24**, (9), 659–664; discussion, 664–666).—A brief description is given of methods of preparing and operating gold cyanide plating solutions.—A. R. P.

***Cathode Efficiency of Electroplating Barrels and Its Effect on the Adhesion of Nickel Deposits.** Albert Hirsch (*Proc. Amer. Electroplaters' Soc.*, **1937**, 97–101; discussion, 102–103).—Adherent nickel deposits cannot be obtained from barrels having loose or moving cathode contacts, or when the cathode current efficiency is less than 31·5%, or the effective current density less than 1 amp./ft.^{2}. Mechanical changes in the barrel may cause the current efficiency to vary between 30 and 99%.—A. R. P.

***The Behaviour of Lead in Nickel Baths.** E. Raub and M. Wittum (*Korrosion u. Metallschutz*, 1937, **13**, (7/8), 261–266).—The behaviour of lead anodes, lead heating coils, and lead tank coatings in the nickel-plating bath depends on the composition of the bath; in the absence of chlorides the lead becomes coated with an adherent film of lead sulphate which may be converted into lead peroxide at high current densities, but does not become loose. When the bath contains chloride, the lead is severely attacked, with the formation of loose lead peroxide, which seriously contaminates the bath; additions of ammonium salts or of citrates to the chloride bath prevents the formation of peroxide slimes. In citrate baths operated at a high current density, passivation of the lead occurs, similar to that observed in sulphate baths, but the film produced is not so protective and relatively large amounts of lead dissolve anodically according to the temperature of operation and the p_H; thus, at p_H 5·8 after 3½ hrs. of operation the bath contained 0·025 grm. of lead per litre. During electrolysis the dissolved lead is deposited with the nickel at the cathode; the lead content of the deposits increases with decreasing current density, with decreasing temperature of operation, and with increasing lead content of the bath; thus with a bath containing 1 grm./litre of lead a nickel deposit made at 0·25 amp./dm.^{2} contained 16·5% lead, whereas a deposit made at 3 amp./dm.^{2} contained only 4·9% lead. With a bath containing only 0·05 grm./litre of lead a deposit made at 0·1 amp./dm.^{2} contained 3·7% lead, while one made at 1 amp./dm.^{2} contained only 0·4% lead. Deposits containing 2–6% lead are lustrous, whereas those with 6–7% are matt and inclined to be spongy.—A. R. P.

Purifying Nickel-Plating Solutions by Electrolysis. Louis Weisberg (*Met. Ind.* (*N.Y.*), 1937, **35**, (9), 451–453).—Copper can be completely removed from a nickel-plating bath by electrolyzing it with a steel cathode at 2 amp./ft.^{2}, removal being complete when the current passed is 2 amp.-hr./gall. of solution. To remove zinc and iron completely in the same way the current requirements are 5 amp./ft.^{2} and 5 amp.-hr./gall. Organic impurities can frequently be removed by electrolyzing at a high current density for a short time. In all cases the p_H of the solution and its nickel content must be suitably adjusted after purification.—A. R. P.

Nickel Plating Problems. H. Krause (*Korrosion u. Metallschutz*, **1937**, **19**, (7/8), 266–269).—Substitutes for nickel plating, the production of sound, non-porous nickel plates of small thickness, and other devices for economizing in nickel are discussed.—A. R. P.

Nickel Saving by Nickel Plating. H. Franssen (*Oberflächentechnik*, 1937, **14**, (17), 174).—Steel heavily plated with nickel may be used for constructional work in place of more expensive materials, such as nickel–bronze.—A. R. P.

The Removal of Electrodeposits of Nickel from Steel. G. E. Gardam (*J. Electrodepositors' Tech. Soc.*, 1937, **14**, 13–16; and *Met. Ind.* (*Lond.*), 1937, **51**, (20), 485–486).—The article is treated anodically in 1 : 1 sulphuric acid, using a potential of more than 2 v.; all the nickel is removed without any attack on the steel. The method may be used for analysis of plated steel. If there are intermediate layers of copper, or if a copper undercoat has been applied, the copper is removed by anodic treatment in ammoniacal ammonium sulphate solution.—A. R. P.

***A Magnetic Method for Measuring the Thickness of Nickel Coatings on Non-Magnetic Base Metals.** Abner Brenner (*Proc. Amer. Electroplaters' Soc.*, 1937, 23–28; discussion, 28–32).—A slightly abridged version of a paper in *J. Res. U.S. Bur. Stand.* (see *Met. Abs.*, this vol., p. 293).—A. R. P.

Methods of Tests of Electrodeposited Coatings of Nickel and Chromium. P. Biget (*Rev. Mét.*, 1937, **34**, (8), 478–480).—Methods used by the French railway authorities in acceptance tests are described. Drop tests for nickel deposits and dissolution tests for nickel and chromium deposits are detailed. —H. S.

Drop Tests for Electrodeposited Nickel Coatings and the French Railway Specifications. Marcel Ballay (*Rev. Mét.*, 1937, **34**, (8), 481–490).—Details are given of the specifications and inspection procedure. B. gives results of tests, photographs showing the effect of the drop test and graphs indicating variation in thickness over the specimen. Precautions to be taken in the tests are indicated (see also abstract below).—H. S.

***Drop Test for Measuring the Thickness of Nickel Electrodeposits.** M. Ballay (*J. Electrodepositors' Tech. Soc.*, 1937, **14**, 1–11; and *Met. Ind.*, (*Lond.*), 1937, **51**, (18), 435–439).—The test consists in placing on the carefully degreased surface 1 drop of a 4 : 1 : 2 mixture of nitric acid, sulphuric acid, and water, allowing it to act for 1 minute, then wiping it off and replacing it with another drop, the process being repeated until the plate is perforated. The deposit is removed at the rate of 1·94 μ of thickness/minute provided that the temperature is maintained at 22·5° C. The solution should be not more than 3 months old, but should be kept at least 1 day before use. Since addition of small quantities of water accelerate dissolution, the solution must be kept in a well-stoppered bottle.—A. R. P.

The Manufacture of Rhodium-Plating Solutions. Lionel Cinamon (*Proc. Amer. Electroplaters' Soc.*, **1937**, 205–210; discussion, 211–212; and *Monthly Rev. Amer. Electroplaters' Soc.*, 1937, **24**, (11), 838–843, 846–848; discussion, 848–851).—The metal (2 oz.) is melted with 20 oz. of lead under a borax flux, the resulting button is cleaned in hydrochloric acid, washed and digested with 5 litres of 1 : 4 nitric acid, and the insoluble black sponge is heated with 400 c.c. of 3 : 1 sulphuric acid until reaction ceases and the temperature reaches 300° C. The cooled liquid is poured into 2 litres of cold water and, next day, the precipitate of lead sulphate and unattacked rhodium is filtered off, digested with sodium carbonate, and, after washing, extracted with nitric acid to remove the lead, leaving a rhodium residue, which is added to the next charge. The main rhodium sulphate filtrate is treated with ammonia until all the rhodium is just precipitated as hydroxide; this is collected, washed free from sulphate, and dissolved in sulphuric acid (4 c.c./grm. of rhodium) or in phosphoric acid (8 grm./grm. of rhodium). The resulting solution is diluted, filtered, and adjusted by addition of water to 2 grm. of rhodium per litre.—A. R. P.

A Résumé of Silver Plating. F. C. Mesle (*Proc. Amer. Electroplaters' Soc.*, **1937**, 104–118; discussion, 119–121; and *Monthly Rev. Amer. Electroplaters' Soc.*, 1937, **24**, (10), 739–747, 750–755; discussion, 756–759).—See *Met. Abs.*, this vol., p. 249.—A. R. P.

***Effect of Free Sodium Cyanide and of Sodium Carbonate on the Cathode Efficiency of a Silver Electroplating Solution.** A. Hirsch, H. Snyder, R. Jackson, Jr., and N. Verrelle (*Proc. Amer. Electroplaters' Soc.*, **1937**, 70–75; discussion, 76–77).—From a sodium argentocyanide plating solution containing 30 grm./litre of silver cyanide and free from carbonate, the best deposit as regards appearance and cathode efficiency (99%) is obtained when the free cyanide content is 10–15 grm./litre. Addition of 50 grm./litre of sodium carbonate produces a soft, white deposit; further additions up to a total of 125 grm./litre do not affect the current efficiency. The bath recommended contains silver cyanide 30, sodium cyanide 22, and anhydrous sodium carbonate 50 grm./litre; it has a resistivity at 24° C. of about 13 ohms/cm.^{3}. —A. R. P.

***Something New in Silver Plating.** Donald Wood (*Proc. Amer. Electroplaters' Soc.*, **1937**, 150–154; discussion, 154–155).—Instead of using the more expensive potassium cyanide for making up silver-plating baths, the less expensive sodium salt may be used, and potassium nitrate added in addition; the recommended bath contains silver nitrate 4, sodium cyanide 4, and potassium nitrate 16 oz./U.S. gall. Accumulation of carbonate is avoided by occasional addition of calcium nitrate when the carbonate concentration is 0·4*N*.—A. R. P.

***The Behaviour of Alloy Anodes in Deposition of Silver–Cadmium Alloys from Cyanide Baths.** Charles L. Faust and Donald J. Henry (*Electrochem. Soc. Preprint*, **1937**, (Oct.), 389–409).—Good, uniform deposits of a 10% cadmium–silver alloy are obtained from a bath containing cadmium 28, silver 1·4, free sodium cyanide 33, sodium carbonate 10 grm., and ammonia 2 c.c./litre, using a current density of 16 amp./ft.^{2} at 30° C. and a 10 : 90 silver–cadmium alloy anode. Similar deposits of a 10% cadmium–silver alloy are obtained, using a homogeneous alloy of the same composition in a bath containing cadmium 15, silver 10, free cyanide 33, sodium carbonate 10 grm., and ammonia 2 c.c./litre, at current densities of 5–10 amp./ft.^{2} at 30° C. Attempts to produce a plate of 2% cadmium–silver alloy in a similar way failed, as the silver in the bath deposited on the anode by chemical displacement; this effect can be mitigated by increasing the anode current density. Micrographs of the structures of some alloy plates are reproduced. —A. R. P.

***Clean Electro-Zinc Coatings.** E. E. Halls (*Metal Treatment*, 1937, 3, (11), 126–130).—Factors which affect the cleanliness, uniformity, and colour of electro-zinc coatings are reviewed, particular attention being given to the cause of dark-coloured, hair-like streaks which may appear either immediately after drying, or after a lapse of time. Experiments are described which show that these may be produced as a result of chlorides (to the extent of more than 2 parts of chlorine per 100,000) or of sulphates (more than 4 parts of SO_3 per 100,000) in the final wash water. A preliminary flash coat of zinc or nickel, and a sulphate electrolyte for the main coating, are recommended.—J. C. C.

The Electrodeposition of Zinc. George B. Hogaboom (*Met. Ind.* (*N.Y.*), 1937, 35, (3), 108–113).—See *Met. Abs.*, this vol., p. 52.—S. G.

Electro-Galvanizing of Round Wire. Arnold Weisselberg (*Wire and Wire Products*, 1936, 11, (6), 281–285, 290).—See *Met. Abs.*, this vol., p. 260.—S. G.

Application and Utility of "Bethanized" Wire. L. H. Winkler (*Wire and Wire Products*, 1936, 11, (5), 228–229).—"Bethanized" wire is produced by electrodepositing pure zinc on iron wire which has been cleaned electrolytically in molten caustic soda. Heavy, uniform deposits which are yet extremely ductile are obtainable, and superior finish and corrosion-resistance are claimed.—J. C. C.

***Laboratory Tests of Electroplated Coatings on Non-Ferrous Metals.** P. W. C. Strausser (*Monthly Rev. Amer. Electroplaters' Soc.*, 1937, 24, (11), 822–834; discussion, 835–836; and *Proc. Amer. Electroplaters' Soc.*, **1937**, 11–21; discussion, 22–23).—Chromium is rapidly removed from nickel by immersion in 1 : 9 hydrochloric acid at 70° C., but for testing zinc-base die-castings the chromium should be removed by anodic treatment in 10% sodium carbonate solution at 2 amp./dm.². Nickel may be stripped from brass by anodic treatment in 66% sulphuric acid at 2 amp./dm.², or in a solution containing 10% of sodium thiocyanate and 10% of sodium bisulphite at 3 amp./dm.². Copper plate is best stripped from zinc by anodic dissolution in 12% sodium sulphide at 2 amp./dm.². The microscopic method is the most suitable for determining local thickness, and the jet test is the best for testing nickel deposits, provided that it is standardized on deposits made from the same bath. Qualitative tests for porosity may be made by the ferroxyl test if the base metal is copper, and by the ammonium trichloroacetate test if the base metal is copper or brass; nevertheless, the salt-spray test is regarded as the most satisfactory.—A. R. P.

Testing the Porosity of Electrodeposited Metals. M. Schlötter and H. Schmellenmeier (*Oberflächentechnik*, 1937, 14, (14), 142–144).—Bright nickel and tin plates have a greater protective action than matt plates since they are much less porous. Knicking, however, causes cracks to develop in bright nickel, but not in bright tin, plates.—A. R. P.

A Discussion on Barrel-Plating. Joseph Underwood (*Proc. Amer. Electroplaters' Soc.*, 1937, 44–47; discussion, 47).—Notes on troubles experienced in barrel-plating nickel, copper, brass, and "black nickel" and on means for preventing them.—A. R. P.

Solution Efficiency. Austin Fletcher (*Monthly Rev. Amer. Electroplaters' Soc.*, 1937, 24, (8), 609–612).—Some data are given for the cathode efficiency in barrel-plating cadmium, zinc, nickel, and copper, and the effect of ageing on them. Cadmium cyanide solutions show very little decrease in efficiency after 5 years. The efficiency of zinc cyanide baths is greatest when the barrel is worked at its maximum load, but an overload decreases the efficiency. Nickel sulphate baths have the longest life and highest efficiency when they are worked at 33° C., with a p_H of 5·8–6·5. Copper cyanide baths have a cathode efficiency of only about 30% in barrel-plating; they work best on a heavy load.—A. R. P.

The Electroplating Circuit. J. H. Hoefer (*Monthly Rev. Amer. Electroplaters' Soc.*, 1937, 24, (8), 601–608).—An elementary educational lecture.
—A. R. P.

***Overvoltage Phenomena in the Electrodeposition of Metals on an Indifferent Cathode.** A. G. Samartzev and K. S. Evstropiev (*Zhurnal Fizicheskoy Khimii* (*J. Phys. Chem.*), 1934, 5, 854–862; *C. Abs.*, 1935, 29, 7822).—[In Russian.] Cf. *Met. Abs.*, 1936, 3, 464. The polarization of smooth and of platinized platinum electrodes was studied in aqueous solutions of cadmium sulphate, salts of copper, lead, mercury, and silver, and in a C_5H_5N solution of silver nitrate at 20°–60° C. The potential-time curves always show a minimum, which is enhanced by the addition of sucrose in the case of cadmium sulphate. The neutralization of ions and deposition of metal atoms on the electrode is shown to be a single-step process.—S. G.

†Meaning and Measurement of Polarization During the Cathodic Deposition of Metals. Friedrich Müller (*Z. Elektrochem.*, 1937, 43, (10), 812–821).—Deposition of metals does not always occur at the reversible electrode potential, the excess potential being termed "overvoltage." The basic processes in metal deposition responsible for this overvoltage are still largely unknown, but are discussed in relation to Gurney's work on hydrogen overvoltage. Difficulties in the theories relating to the structure of the double layer responsible for overvoltage, and to the mechanism by which this double layer is formed, are discussed. Practical methods for the determination of overvoltage directly, and by the commutator method, are considered, together with possible explanations of the poor reproducibility often noted at high current densities. A *bibliography* of about 170 references is given.—L. E. P.

***Interferometric Observations of Current Anomalies on Cathodes.** H. J. Antweiler (*Z. Elektrochem.*, 1937, **43**, (8), 596–597; discussion, 597).—Abstract of a paper (with discussion) read before the Deutsche Bunsen-Gesellschaft. By the interferometer method, the diffusion layer formed during the electrolysis with a mercury drop cathode was rendered visible and the excessive current intensity was traced to an agitation effect. Two types of current formation were observed, according as to whether the precipitation potential was more positive ($Hg^{\cdot\cdot}$, $Cu^{\cdot\cdot}$, $Fe^{\cdot\cdot\cdot}$) or more negative ($Ni^{\cdot\cdot}$, $Mn^{\cdot\cdot}$) than the electrocapillary null-potential of mercury. The phenomenon is the more pronounced the lower is the conductivity of the solution in relation to the concentration of cations.—J. H. W.

***Formation of Pits in Electrodeposits.** B. Kabanov and E. Faingluz (*Zhurnal Fizicheskoy Khimii* (*J. Phys. Chem.*), 1936, **8**, (6), 795–799).—[In Russian.] A study was made of zinc deposits obtained under various conditions. The change in pitting in an acid electrolyte on increase in current density, and its absence in presence of cyanides, is due to a change in the angle of contact of the gas bubbles, and not to a change in the amount of hydrogen evolved. Pit formation can be prevented by the addition of surface-active substances (*e.g.* amyl alcohol or *p*-cresol) which decrease the angle of contact of the gas bubbles. The observed results can be explained by the capillary theory of the wetting of metals.—N. A.

†**Recent Advances in the Testing and Production of Electrodeposits.** W. N. Bradshaw (*Metal Treatment*, 1937, **3**, (10), 77–80, 83).—A review. Reference is made to the B.N.F. jet-test, and the Mesle chord test for determining the local thickness of deposits, and to the hot-water and ferricyanide tests for porosity. Recent developments in bright nickel plating, in tin, rhodium, platinum, bronze, and other alloy baths, deposits for wear-resistance, and anodically-produced coatings are briefly discussed. There is a *bibliography* of 24 references.—J. C. C.

Experiences in Evaluating Plated Coatings. W. L. Pinner and L. B. Sperry (*Proc. Amer. Electroplaters' Soc.*, **1937**, 33–40; discussion, 41–43).—Subjects broadly discussed are: the ferroxyl and salt-spray tests for porosity, the drop method for testing the thickness of chromium plate and the effect of temperature variations on the results, the microscopic measurement of the thickness of plated coatings, and the causes of failure of plated coatings.—A. R. P.

Measurement of the Thickness of Electrodeposits. —— (*Sheet Metal Ind.*, 1937, **11**, (123), 637–638, 652; (124), 724–725).—See *Met. Abs.*, this vol., p. 400.—L. A. O.

***Removal of Carbonate from Cyanide Plating Baths with Gypsum.** R. O. Hull (*Proc. Amer. Electroplaters' Soc.*, **1937**, 164–168; discussion, 169–172).—Agitation of cyanide plating baths with finely-ground gypsum effectively removes carbonate, but substitutes sulphate; cooling of the filtered solution to 10° C., and inoculation with a crystal of Glauber's salts causes most of the sulphate to separate as $Na_2SO_4,10H_2O$ crystals, leaving a maximum of 8% of sodium sulphate in solution, which amount has no deleterious effect on the operation of zinc, cadmium, copper, or silver plating baths. The reaction of the gypsum with the sodium carbonate is practically stoicheiometric, so that if the carbonate content of the bath is first determined, any desired amount can be removed by addition of the appropriate amount of gypsum and agitation for 1 hr. If desired, an excess of gypsum may be allowed to remain at the bottom of the bath, to prevent accumulation of carbonates therein.—A. R. P.

The p_H of Alkaline Plating Baths. George B. Hogaboom (*Proc. Amer. Electroplaters' Soc.*, **1937**, 181–190; discussion, 191–196; and *Monthly Rev. Amer. Electroplaters' Soc.*, 1937, **24**, (10), 713–716, 718, 720–730; discussion, 731–738; and (abridged) *Met. Ind.* (*Lond.*), 1937, **51**, (13), 317–320).—The effects of varying p_H on the character of the deposits and on the anode and cathode efficiencies are reported for various copper, zinc, silver, cadmium, and brass solutions. Blisters and peeling of deposits from an alkaline solution are thought to be due mainly to its p_H value.—H. W. G. H.

The Prevention of Spotting Out. A Review of Conditions Affecting the Occurrence of Crystal and Stain Spotting and Methods for Their Prevention. Gustave Klinkenstein (*Proc. Amer. Electroplaters' Soc.*, **1937**, 78–82; discussion, 82–85; and *Monthly Rev. Amer. Electroplaters' Soc.*, 1937, **24**, (9), 647–650, 652–653; discussion, 653–657).—A review of the subject.—A. R. P.

Losses from Plating Solutions. Plating Economy Demands Control of "Drag-Out." George B. Hogaboom (*Met. Ind.* (*Lond.*), 1937, **50**, (5), 219–222).—See *Met. Abs.*, this vol., p. 554.—S. G.

Simple [Plating] Ideas That Worked. W. S. Barrows (*Proc. Amer. Electroplaters' Soc.*, **1937**, 122–135).—Practical hints are given for overcoming many minor difficulties often occurring in plating operations.—A. R. P.

Advances in the Field of Plating Apparatus. G. Elssner (*Korrosion u. Metallschutz*, 1937, **13**, (7/8), 241–247).—An illustrated article describing modern types of plating plant for continuous operation from the degreaser to the final burnishing barrel.—A. R. P.

Health Hazards in the Plating Industry. F. N. Carlson (*Proc. Amer. Electroplaters' Soc.*, **1937**, 86–91; discussion, 91–96; and *Monthly Rev. Amer. Electroplaters' Soc.*, 1937, **24**, (8), 585–586, 588–593; discussion 593–599).—The hazards discussed are: silicosis, skin irritation from cleaning tanks, nickel itch, chromic acid dermatitis, lead poisoning, and cyanide poisoning. Means for avoiding trouble, and remedies when the trouble has developed, are briefly described.—A. R. P.

Ventilation of Acid-Dipping and Electroplating Rooms. Edward C. De Lorme (*Proc. Amer. Electroplaters' Soc.*, **1937**, 160–162; discussion, 162–163).—Methods of hooding tanks from which acid or other noxious spray is evolved are discussed with reference to the selection of suitable corrosion-resistant materials for the purpose.—A. R. P.

†**Electrolytic Processes.** H. J. T. Ellingham (*J. Inst. Elect. Eng.*, 1937, **80**, (482), 207–211).—A review of progress during the past few years, in the fields of: (*a*) electrolytic extraction of metals from aqueous solutions, and from fused salts; (*b*) electrolytic refining and parting of metals; and (*c*) electroplating and electroforming.—S. V. W.

Electroplating in Europe and the First International Conference on Electrodeposition. Walter R. Meyer (*Proc. Amer. Electroplaters' Soc.*, **1937**, 48–67; discussion, 67–69).—Modern practice in plating nickel, chromium, cadmium, zinc, silver, copper, tin, gold, rhodium, and platinum in the British Isles and on the Continent is briefly described.—A. R. P.

Summary of Activities on Electrodeposition at the National Bureau of Standards, June 1, 1936, to June 1, 1937. William Blum (*Monthly Rev. Amer. Electroplaters' Soc.*, 1937, **24**, (11), 811–812, 814–815; and *Proc. Amer. Electroplaters' Soc.*, **1937**, 2–4).—A brief account of the work carried out on electroplating subjects.—A. R. P.

The Future of Electrodeposition. H. J. T. Ellingham (*Metal Cleaning and Finishing*, 1937, 9, (3), 183–184, 238).—See also *Met. Abs.*, 1936, 3, 464.—S. G.

VII.—ELECTROMETALLURGY AND ELECTROCHEMISTRY

(Other than Electrodeposition.)

(Continued from pp. 528–531.)

***Production of Silico-Aluminium.** P. V. Golubkov and M. N. Miroshnikova (*Legkie Metally* (*Light Metals*), **1937**, (5/6), 6–9).—[In Russian.] A silico-aluminium containing 65–75% Si, and iron $< 1{\cdot}5\%$ is obtained by electric smelting, in a furnace of the type used in carbide production of a mixture of kaolin, quartz sand, and charcoal, with an energy consumption of about 12,000 kw.-hr./ton of alloy.—D. N. S.

***Investigation of the Electrothermal Production of Magnesium–Aluminium–Silicon Alloys, and of the Preparation of Pure Magnesium from These Alloys.** J. K. Berent (*Legkie Metally* (*Light Metals*), 1937, **6**, (2), 18–24).—[In Russian.] Alloys containing 2–5% magnesium can be obtained by electrothermal reduction of mixtures of magnesia (40–50%) with kaolin or alumina, silica, and coal.—D. N. S.

***Electrolytic Production of Magnesium–Zinc Alloys.** V. M. Guskov and H. L. Strelets (*Trudi Vsesouznogo Aluminievo-Magnievovo Instituta* ("*VAMI*") (*Trans. Aluminium-Magnesium Inst.*), **1937**, (14), 71–80).—[In Russian.] In the production of magnesium–zinc alloys by electrolysis of fused carnallite above a molten zinc cathode at 560°–730° C., temperature has little effect on the current yield until the magnesium content of the cathode reaches 30%, after which the highest yield (90%) is obtained at 550°–680° C., using a current density of 1·2 amp./cm.^{2}. The energy consumption is about 13 kw.-hr./kg. of magnesium.—D. N. S.

The Problem of Electrolytic Baths with a Liquid Cathode. P. G. Egizarov (*Legkie Metally* (*Light Metals*), 1937, **6**, (3), 14–16).—[In Russian.]—D. N. S.

***On the Electrochemical Behaviour of Rhodium. IV.—Transport Number and p_H Measurements in Hydrochloric Acid and Rhodium Trichloride Solutions.** G. Grube and Hans Autenrieth (*Z. Elektrochem.*, 1937, **43**, (11), 880–886).—Some aspects of rhodium deposition are considered. The rhodium is in solution largely as complexes such as $H_3[RhCl_3(OH)_3]$.—L. E. P.

Normal Volta Potentials $\Delta\psi$ of Important Electrochemical Two-Phase Systems, with Special Reference to the Electrodes: Metal/Metal Solution. Otto Klein and Erich Lange (*Z. Elektrochem.*, 1937, **43**, (10), 826).—Corrections to an earlier paper by K. and L. (*Met. Abs.*, this vol., 528).—L. E. P.

***Relations Between the Number of Crystallization Nuclei Formed and the Concentration of Electrolyte Used in Electrolysis.** A. T. Wahramian and S. A. Alemian (*Acta Physicochimica U.R.S.S.*, 1937, **7**, (1), 95–100).—[In German.] The production of silver-crystallization nuclei upon the platinum cathode used in conjunction with a silver anode in the electrolysis of solutions of silver nitrate of concentrations 0·1–2*N* is studied experimentally by means of a microscope. The results show that, under similar conditions, the most probable value of the number of crystallization nuclei formed by electrodeposition on the cathode is inversely proportional to the concentration of the electrolyte.—J. S. G. T.

VIII.—REFINING

(Continued from pp. 251–253.)

The Electrolytic Refining of Tin in Sulphuric Acid Solutions. S. A. Pletenov and V. N. Rosov (*Zvetnye Metally* (*Non-Ferrous Metals*), **1936**, (9), 79–85).—[In Russian.] Tin of not less than 99·9% purity can be obtained by electrolyzing solutions containing about 2% impurities. Benzenesulphonic acid and glue are added to the acid solution of stannous sulphate, and the electrolysis is carried out at 35° C., with a current density of 100 amp./m.^{2}. The tin anodes become passive in the course of electrolysis, on account of deposition of a solid salt film from the saturated anodic solution. This film can be removed by mechanical cleaning.—N. A.

Precious Metals Refinery of the Mond Nickel Co. C. Busquet (*Metalurgia y constr. mecan.*, 1936, **2**, 1).—Describes the Acton refinery.—S. G.

IX.—ANALYSIS

(Continued from pp. 531–536.)

†**The Present Position of Emission Spectrographic Analysis.** Wolfgang Seith (*Z. Metallkunde*, 1937, 29, (8), 252–256).—A review of modern methods, their application and accuracy, with especial reference to light metal analysis. —A. R. P.

†**Advances in the Technique of Spectrographic Analysis.** Walther Gerlach and W. Rollwagen (*Metallwirtschaft*, 1937, **16**, (43), 1083–1094).—Recent advances are reviewed, with special reference to quantitative methods.—v. G.

***Contributions to Quantitative Spectrographic Analysis, Especially of Light Metals.** H. Kaiser (*Metallwirtschaft*, 1937, **16**, (43), 1095–1101).—Taking as example the 9% Mg–Al alloy, the influence of discharge conditions, shape of electrodes, time of sparking, and structure of the alloy on the accuracy of the analysis is discussed.—v. G.

Photometric Methods in the Field of Light Metal Analysis. H. Ginsberg (*Metallwirtschaft*, 1937, **16**, (43), 1107–1112).—The colorimetric determination of Ti, Cr, V, Cu, and Fe in pure and very pure Al is described in detail, and possible sources of error are pointed out.—v. G.

***Analysis of Light Alloys. [I.—] The Polarographic Analysis of Magnesium Alloys.** H. C. Gull (*J. Soc. Chem. Ind.*, 1937, **56**, (6), 177–179T).—Automatic recording of current–voltage curves for a dropping Hg cathode can be used for determining 1–10% Al, 0–1% Zn, 0–0·5% Mn, and 0–0·1% Pb in Mg alloys with an accuracy of ± 2%. The solution used is obtained by dissolving the alloy in HCl, neutralizing to p_H 3·8 with KOH, and completely deoxygenating by passing a current of H_2 through it for some hours; records are then obtained of the Pb, Zn, and Al contents, which give waves at − 0·46, −1·06, and − 1·7 v., respectively. If Mn is present the Al is removed by addition of $CH_3.CO_2K$, and after H_2 treatment the solution is treated as before; Mn gives a distinct wave at − 1·5 v.—A. R. P.

***Analysis of Light Alloys. [II.—] The Determination of Aluminium by Titration with Alkali.** A. E. Martin (*J. Soc. Chem. Ind.*, 1937, **56**, (6), 179–180T).—The electrometric method consists in titrating a slightly acid sulphate solution with 0·05*N*-NaOH using a solution of standard p_H as reference; the Al content is proportional to the distance between the two vertical sections of the resulting curve (*i.e.* NaOH *versus* galvanometer deflection). The titration can also be made with indicators in a Nessler tube; the alkali is cautiously added until bromophenol-blue indicator just becomes colourless (p_H 3·7), methyl-red is then added and the titration continued until the colour changes from red to a neutral tint, the second titration giving the Al content of the solution.—A. R. P.

***Analysis of Light Alloys. [III.—] The Spectrographic Analysis of Magnesium Alloys.** H. Kenneth Whalley (*J. Soc. Chem. Ind.*, 1937, **56**, (6), 180–183T).—The spark spectrum of the alloy is taken with exposures of 5, 10, and 20, or 10, 20, and 40 seconds, and the intensities of the lines at an arbitrary standard exposure are obtained by interpolation, the blackening of Mg 2916 A. being taken as a measure of the exposure and for comparing the blackening of the lines of the alloying element. The following lines are used: for Al 3944 or 2568 A., for Cu 3274 A., for Zn 3303 A., and for Mn 2949, 2606, or 2594 A. Some examples of the method are given.—A. R. P.

***The Electrolytic Analysis of White and Yellow Metal Alloys.** Sydney Torrance (*Analyst*, 1937, 62, (739), 719–722).—The alloy is dissolved in 20 c.c. of 1 : 1 HCl with the aid of a few crystals of $KClO_3$; after boiling off Cl_2, 5 c.c. of HCl, water to 150 c.c., and 1 grm. of N_2H_4,2HCl are added, and the solution is electrolyzed at 70°–75° C., with an auxiliary potential of 0·4 v., to deposit

Cu + Sb. The deposit is weighed and dissolved in 20 c.c. of a 1 : 1 : 2 HNO_3–HF–H_2O mixture, the solution being then diluted to 150 c.c., oxidized with $K_2Cr_2O_7$, and again electrolyzed as before, to deposit Cu only. The solution from which the Cu + Sb were removed is treated with a further 1 grm. of N_2H_4,2HCl, and electrolyzed with an auxiliary potential of 0·7 v., to deposit Sn + Pb; the weighed deposit is dissolved in the above HNO_3–HF mixture, and the solution electrolyzed, to deposit Pb on the anode as PbO_2, a known weight of Pb being added if only little is present in the alloy. A somewhat similar process is described for the analysis of brass, bronze, and leaded bronzes. If Zn is to be determined, the solution from the Sn–Pb electrolysis is made ammoniacal, and the Zn deposited under the usual conditions.—A. R. P.

***Analysis of Platinum Metals—Silver Assay Bead.** F. E. Beamish and M. Scott (*Indust. and Eng. Chem.* (*Analyt. Edn.*), 1937, **9**, (10), 460–463).—The bead is parted with 30–40 c.c. of 95% H_2SO_4, kept at just a sufficiently high temperature to ensure a uniform rapid rate of parting. The liquid, after cooling, is diluted to 175 c.c., filtered through a close paper, evaporated to 4–5 c.c., diluted to 200 c.c., and boiled with $NaBrO_3$ and $NaHCO_3$ to p_H 6 to precipitate PdO_2, which is redissolved and determined by the glyoxime method, any Ag present being previously removed. The residue from the parting is extracted with hot 50% $CH_3·CO_2NH_4$ solution, to remove $PbSO_4$, then with 3 : 1 aqua regia, to dissolve Pt, Au, and Ag, dried in a Ag crucible, and fused with Na_2O_2 for the determination of Rh and Ir by Gilchrist's method. The aqua regia solution is evaporated, AgCl removed, the Au precipitated with hydroquinone, any Pd present with dimethylglyoxime, and the Pt with H_2S. —A. R. P.

***Microscopical and Chemical Investigations on Clad Metals.** Carl Schaarwächter (*Z. Metallkunde*, 1937, **29**, (8), 270–276).—The depth of the diffusion zone in cupro-nickel-clad iron can be determined by measurement under the microscope, or by actually isolating the film; this is done by dissolving the cupro-nickel in $CH_3.CO_2H$ to which $NaNO_2$ is added, and then dissolving the Fe in 5% $(NH_4)_2S_2O_8$ solution. If the Fe contains S, this diffuses into the cupro-nickel layer, where it forms Cu_2S along the grain boundaries, and eventually produces brittleness. Annealing in H_2 at 1000° C. removes the S as H_2S, and increases the thickness of the Fe–Ni diffusion film. Full details are given of methods for analyzing both layers in bimetals, one layer of which is a ferrous metal and the other a Cu or Cu–Ni alloy.—A. R. P.

Special Reaction of N. A. Tananaev and A. V. Tananaeva for Zirconium. I. P. Alimarin (*Zhurnal Prikladnoĭ Khimii* (*J. Applied Chem.*), 1936, **9**, (9), 1697–1699 (in Russian); and (in German) *Z. anal. Chem.*, 1936, **106**, 276–279).—A. points out the analogy between T. and T.'s method and that of C. H. Bailey (*J. Chem. Soc.*, 1886, **49**, 149, 481), and remarks on some doubtful points in the suggested course of analysis.—N. A.

***Studies on the Quantitative Separation of Metals by Alkali Chromate. I.—On the Equilibrium between Chromate and Dichromate in Aqueous Solution.** Hisaji Katô and Takeo Watase (*Nippon Kwagaku Kwai Shi* (*J. Chem. Soc. Japan*), 1937, **58**, (4), 354–361; *C. Abs.*, 1937, **31**, 5293).—[In Japanese.] By the use of the light filter of 5300 A., the concentration of $Cr_2O_7^{--}$ in an aqueous solution of $K_2Cr_2O_7$ was determined, and the equilibrium between $Cr_2O_7^{--}$ and CrO_4^{--} was determined at different p_H values.—S. G.

Quantitative Separation of Aluminium from Manganese, Nickel, Cobalt, and Zinc. Toshio Kōzu (*Nippon Kwagaku Kwai Shi* (*J. Chem. Soc. Japan*), 1935, **56**, (1), 22–30; *C. Abs.*, 1935, **29**, 2879).—[In Japanese.] Al alone is precipitated by means of $(CH_2)_6N_4$ at room temperature (1 mol. slightly acidic with H_2SO_4) from the mixture containing Al, Mn, Ni, and Co.—S. G.

***Studies on Quantitative Separation of Metals by Hydrogen Sulphide. VIII.—A Method for Separating Aluminium from Iron, Nickel, and Cobalt.** Hisaji Katô (*Nippon Kwagaku Kwai Shi* (*J. Chem. Soc. Japan*), 1935, **56**, (2), 210–

212; *C. Abs.*, 1935, **29**, 3255).—[In Japanese.] The precipitation of FeS, NiS, and CoS with H_2S at a suitable p_H, and the precipitation of basic Al acetate by boiling the filtrate after adding NaOAc, are described.—S. G.

Quantitative Separation of Aluminium from Manganese, Nickel, Cobalt, and Zinc. Toshio Kōzu (*Nippon Kwagaku Kwai Shi* (*J. Chem. Soc. Japan*), 1935, **56**, (6), 683–688; *C. Abs.*, 1935, **29**, 6167).—[In Japanese.] From mixtures of sulphate, Al can be precipitated quantitatively at room temperature by the addition of saturated aqueous solution of aniline. No interference was caused by the presence of K, Mn, Ni, or Co, but some trouble was encountered with Zn. —S. G.

***Studies on the Quantitative Separation of Metals by Alkali Chromate. II.—On the Quantitative Separation of Barium from Strontium.** Hisaji Katô and Takeo Watase (*Nippon Kwagaku Kwai Shi* (*J. Chem. Soc. Japan*), 1937, **58**, (4), 362–369).—[In Japanese.]—S. G.

Chemical Analysis of Alkali Metals. I.—Separation of Alkali Metals. II.—Determination of Alkali Metals. Takio Katô (*Nippon Kwagaku Kwai Shi* (*J. Chem. Soc. Japan*), 1935, **56**, (4), 373–397; *C. Abs.*, 1935, **29**, 5037).—[In Japanese.] (I·—) AcOMe instead of EtOH is recommended for dissolving Na_2PtCl_6 and Li_2PtCl_6; the remaining perchlorates do not dissolve. (II·—) Details are given for separating Na and Li from other alkali metals by treating the chloroplatinates with AcOMe, for determining Rb as $Rb_4P_2O_7.24WO_3$, Cs as $Cs_4P_2O_7.24WO_3$, and Li as Li_2SO_4.—S. G.

***Studies on the Elimination of the Effect of the PO_4-Radical in Quantitative Analysis.—V.** Saburo Ishimaru (*Nippon Kwagaku Kwai Shi* (*J. Chem. Soc. Japan*), 1935, **56**, (1)).—[In Japanese.] See *Met. Abs.*, 1936, **3**, 46.—S. G.

An Improvement in the Determination of Aluminium in the Presence of Large Amounts of Iron. Takeshige Honjo (*Nippon Kwagaku Kwai Shi* (*J. Chem. Soc. Japan*), 1936, **57**, (7), 682–684; *C. Abs.*, 1936, **30**, 6669).—[In Japanese.] Ishimaru's method (*Met. Abs.* (*J. Inst. Metals*), 1933, **53**, 200), using $Na_2S_2O_3$ and phenylhydrazine, is recommended.—S. G.

Alkalimetric Determination of Aluminium in the Presence of Monohydroxy-carboxylic Acids. A. V. Pavlinova (*Zhurnal Prikladnoĭ Khimii* (*J. Applied Chem.*), 1936, **9**, (9), 1682–1689).—The $AlCl_3$ solution is treated with a slight excess of alkali lactate, and titrated with NaOH until the phenolphthalein indicator becomes just pink. The solution is then heated to boiling, and more NaOH added until the pink persists on prolonged boiling; the difference in the two titrations is the amount of NaOH equivalent to the Al ($3NaOH \equiv 1 Al$). A similar method, using sodium citrate and thymolphthalein, is described for the analysis of alum.—N. A.

***Alkali Determination of Aluminium in Presence of Salts of Hydroxycarboxylic Acids.—II.** A. V. Pavlinova (*Zhurnal Prikladnoĭ Khimii* (*J. Applied Chem.*), 1937, **10**, (4), 732–739).—[In Russian.] Al can be titrated with alkali in the presence of salicylic, tartaric, lactic, or citric acids; the procedure is described in detail.—N. A.

***The Determination of Alumina in the Presence of Metallic Aluminium.** G. B. Brook and A. G. Waddington (*J. Inst. Metals*, 1937, **61**, 309–320; discussion, 320–322).—A description is given of a study of the volatilization process for the determination of Al_2O_3 in the presence of metallic Al, using HCl. After reviewing the previous methods suggested for this determination, a description is given of a modified process and of the required apparatus. The method has proved superior to any yet proposed for determining Al_2O_3 in granulated Al dross, &c., and results are given showing the application of the method to such aluminous materials.—G. B. B.

***On the Colorimetric Determination of Cadmium as Sulphide. (Colorimetry with Colloidal Solutions.—II.)** Robert Juza and Robert Langheim (*Z. anal. Chem.*, 1937, **110**, (5/6), 262–270).—The method depends on the formation of colloidal CdS in a KCN solution containing gelatin. Zn up to 1000 times the Cd does not interfere.—A. R. P.

The Estimation of Traces of Chlorine in Magnesium. H. Herlemont (*Métaux et Corrosion*, 1937, 12, (140), 73).—The sample is dissolved in HNO_3 containing $AgNO_3$, filtered, and washed. The AgCl precipitate is dissolved in dilute NH_4OH, and made up to 50 c.c. with distilled water. Drops of Na_2SO_4 solution are added, and the colour obtained is compared with those of standards.—J. H. W.

***Dipotassium Sodium Cobaltinitrite and Its Application to the Gravimetric Determination of Cobalt.** C. F. Cumbers and J. B. M. Coppock (*J. Soc. Chem. Ind.*, 1937, **56**, (10), 405–407T).—Co may be determined by precipitating it as $K_2NaCo(NO_2)_6,H_2O$ at 60° C. in a solution containing 4% $CH_3.CO_2H$ by addition of a solution of 30 grm. NaCl and 1·25 grm. KCl in 35 c.c. warm (70° C.) water; the precipitate is collected in a glass crucible, washed with a saturated solution of the compound, and dried at 120° C. for weighing. The presence of Ni up to a Ni : Co ratio of 1 : 1 does not interfere; larger amounts give a slightly high result. When Co is precipitated with 8-hydroxyquinoline the precipitate should be dried *in vacuo*, preferably after washing with $C_2H_5.OH$ (saturated with the compound), then with $(C_2H_5)_2O$; the compound then contains 1·75 H_2O (Co factor 0·1557).—A. R. P.

***On the Colorimetric Determination of Copper as Ferrocyanide. (Colorimetry with Colloidal Solutions.—III.)** H. Hahn, R. Juza, and R. Langheim (*Z. anal. Chem.*, 1937, **110**, (5/6), 270–275).—The Cu is precipitated in a slightly acid $CH_3 \cdot CO_2H$ solution containing gelatin by addition of $K_4Fe(CN)_6$, and the colour compared with that of a standard similarly prepared. Up to 1000 times as much Pb does not interfere.—A. R. P.

***The Colorimetric Determination of Copper with Sodium Diethyldithiocarbamate in the Presence of Moderate Amounts of Iron.** T. P. Hoar (*Analyst*, 1937, **62**, (738), 649–702).—The interference of Fe can be prevented by addition of citrates or $Na_4P_2O_7$; details of the modified methods are given. —A. R. P.

***The Determination of Gold by Direct Parting.** August Hackl (*Z. anal. Chem.*, 1934, **98**, (5/6), 166–167).—In the assay of Au alloys by cupellation, loss of Au occurs by volatilization and by absorption in the cupel; these errors may be avoided by inquarting the alloy with Ag or Cu under borax on charcoal, using a small blowpipe flame. The resulting bead is hammered, and rolled to a strip, which is coiled, annealed, and parted in two strengths of HNO_3 in the usual way. Cu should be used for inquarting alloys containing Ni; the Au obtained from the parting in this case is only 998-fine, but the results are consistent and allowance can therefore be made for impurities. The method should not be used when the alloy contains more than 0·5% Sn or more than 1·5% Pt.—A. R. P.

***Rapid Determination of Lead in Tin Solder.** S. Rempel (*Zhurnal Prikladnoi Khimii* (*J. Applied Chem.*), 1937, **10**, (5), 932–935).—[In Russian.] The alloy (0·1–0·2 grm.) is dissolved in 5 c.c. of HNO_3 (d 1·4), the solution is diluted to 25 c.c., and the Pb deposited as PbO_2 in a Pt dish, using current at 5 amp./dm.² and keeping the solution at 90° C. The results are accurate to ± 0·02–0·05%, and the analysis can be completed in 1 hr.—N. A.

***On the Determination of Lead by Means of 8-Hydroxyquinoline.** V. Hovorka (*Coll. trav. chim. Tchécoslov.*, 1937, **9**, (5), 191–206).—[In French.] Addition of 8-hydroxyquinoline to a neutral acetate solution of Pb followed by NH_4OH to a concentration of 2·5% affords a quantitative precipitation of Pb oxine which may be collected next day, dried at 105° C., and weighed. —A. R. P.

***Colorimetric Determination of Lead in Solutions of Low Concentration, by Fischer's Dithizone Method, with the Use of Coloured Glasses.** A. V. Evlanova (*Zhurnal Prikladnoĭ Khimii* (*J. Applied Chem.*), 1936, **9**, (9), 1690–1695).—

[In Russian.] The dithizone method has been examined for Pb concentrations of 0·001–50 mg./litre, with especial reference to the effect of volume of solution and volume of reagent added, the limiting concentration, the p_H of the solution, and a standard scale.—N. A.

***Determination of Osmium in a Lead Assay Button.** J. J. Russell, F. E. Beamish, and J. Seath (*Indust. and Eng. Chem.* (*Analyt. Edn.*), 1937, 9, (10), 475–477).—In the cupellation of a Pb button from the fire assay, no Os remains in the Ag, Ag–Pt, Ag–Pd, or Ag–Au bead, but small amounts are retained if Ru, Ir, or Rh is present. Collection by Pb is efficient only when the sample contains less than 5 mg. of Os; on dissolving the Pb in HNO_3 some Os distils over as OsO_4.—A. R. P.

A Qualitative Test for Molybdenum. R. H. Lowe (*Eng. and Min. J.*, 1937, 138, (11), 54).—Describes a qualitative test for Mo in ores and alloys, based on the fact that the reaction product of a xanthate and a Mo compound is highly coloured. The method is not claimed to be new, but a definite procedure is outlined from experience. The sensitivity of the test is given.
—R. Gr.

***The Colorimetric Determination of Tin by Means of Toluene-3 : 4-dithiol ("Dithiol").** R. E. D. Clark (*Analyst*, 1937, 62, (738), 661–663).—The Sn solution is treated with a few drops of thioglycollic acid, to reduce the $Sn^{····}$ to $Sn^{··}$, and diluted until it contains less than 60 p.p.m. of Sn; 5 c.c. of this solution are treated with 1 c.c. of HCl, 1 c.c. of agar-agar, boiled, cooled, treated with 2 c.c. of "dithiol" solution, immersed in hot water for 1 minute, and transferred to the Lovibond tintometer, where the red units are measured in reflected light. The dithiol solution contains 0·2 grm. of the compound in 100 c.c. of 1% NaOH, to which 0·3–0·5 grm. of thioglycollic acid is then added.—A. R. P.

X.—LABORATORY APPARATUS, INSTRUMENTS, &c.

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

(Continued from pp. 536–537.)

A Note on Rapid Photomicrography. Willard Mutchler and Henry O. Willier (*Amer. Soc. Metals Preprint*, **1937**, (Oct.), 7 pp.).—The time involved in photomicrography is reduced by replacing the individually-loaded plateholder normally used by a roll-holder permitting 900 autographed exposures from one loading; constructional details are given. The image is focussed in an auxiliary eye-piece. The substitution of bromide emulsion paper for film as the negative material reduces costs; good-quality prints may be made, but, as the paper negatives reveal sufficient detail for routine purposes, are unnecessary.—G. V. R.

Improved Illumination for Microscopes. Peter P. Tarasov (*Metal Progress*, 1937, 32, (3), 266–267).—An illustrated description is given of an arc lamp having cylindrical tungsten electrodes and resembling the "sun" lamp; the necessary mounting and adjustments are described.—P. R.

Vickers Projection Microscope. —— (*Wild-Barfield Heat-Treat. J.*, 1937, 2, (14), 81–83).—This instrument, which is of exceptionally robust design, is intended for works use. Diagrams are given of the illuminating gear and optical system.—P. R.

A Simple Metallographical Microscope. H. Freund (*Germanskaia Tehnika* (*Z. deut. Technik*), 1936, 15, 8–9, 138–139).—[In Russian.] A description of the Leitz vertical microscope.—N. A.

Relation between Surface Condition and Luminous Dispersion. F. Canac (*Mécanique*, 1937, 21, (274), 209–210).—A method is discussed for comparing the dispersive power of metallic surfaces. The apparatus employed is illustrated, and it is stated that the method permits progressive observations on the development of cracks or of corrosive attack.—P. R.

***On the Method of Measuring the Oxidation Equilibrium of a Metal by Carbon Dioxide.** Kôkiti Sano (*Nippon Kwagaku Kwai Shi* (*J. Chem. Soc. Japan*), 1936, **57**, (10).—[In Japanese.] See *Met. Abs.*, this vol., p. 156.—S. G.

Apparatus for Quantitative Spectrographic Analysis. Henri Triché (*Rev. d'Optique*, 1937, **16**, (5), 161–168).—A description is given of a two-spark apparatus, in which two spectra are observed under identical conditions; materials of unknown composition can thus be compared with standard samples. A sector comparator is employed. The method is said to be especially applicable to the superficial or local testing of samples.—P. R.

Machined Metal Stuffing-Box Seals Adapted to High-Vacuum Technique. L. P. Garner (*Rev. Sci. Instruments*, 1937, [N.S.], **8**, (9), 329–332).—Vacuum seals machined from metals, and adapted to vacuum technique, are described and shown in several forms suitable for joining metal and glass components. Precautions to be taken in construction and use are given. Dimensional working drawings for several sizes of one type are shown.—S. G.

Instrument Suspensions. L. Walden (*J. Sci. Instruments*, 1937, **14**, (8), 258–268).—Filaments of fused silica, and very fine metal wire, are increasingly used in sensitive instruments. W. describes the production and manipulation of various suspensions, with methods of securing electrically-conducting coatings on non-conducting materials, as well as details of their use in specific instruments.—W. H.-R.

High-Intensity X-Ray Spectrograph with a Bent Crystal. N. D. Borisov and J. M. Vogel (*Zhurnal Tehnicheskoy Fiziki* (*J. Tech. Physics*), 1937, **7**, (2), 164–170).—[In Russian.] The instrument described requires no adjustments during use in the relative positions of crystal holder and plate holder. The operation of the instrument is described, and photographs obtained with it are shown.—N. A.

***A Simple X-Ray Tube with Small Energy Consumption. Contribution to the Wide-Angle Method.** B. Hesz (*Zeit. Krist.*, 1937, **97**, (3), 197–207).
—W. H.-R.

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

(Continued from pp. 537–544.)

A New Classification of Metallurgical Products. P. Blanchet (*Rev. Mét.*, 1937, **34**, (9), 513–519).—Read before the Association Française pour l'Essai des Matériaux. The use of a classification based on the minimum values required in the usual mechanical tests used for acceptance purposes, and based on the requirements of the user, is advocated for groups of steels having similar physical properties, but differing in tensile properties, shock-resistance, and fatigue properties. Specifications would leave open to the producer the method of manufacture, chemical composition, and treatment. Advantages and disadvantages of the system are indicated, from the points of view of producer, user, and national defence requirements.—H. S.

Classification of the Principal Industrial Alloys of Aluminium. J. Douchement (*Rev. Mét.*, 1937, **34**, (9), 520–524).—Read before the Association Française pour l'Essai des Matériaux. Six aluminium alloys of simple types are taken as the basis of classification. These are Al–Cu, Al–Si, $Al–Mg_2Si$, Al–Mg, Al–Zn, and Al–Mn. As the scope of each type is very wide, subdivisions are proposed, the silicon alloy type being subdivided into groups, each of practical importance, viz. alloys containing silicon $< 10\%$, 10 to 14%, and $> 14\%$. A point of great importance, from the industrial point of view, is that of scrap recovery. The classification is not regarded as perfect, but possesses advantages, in that new groups can be added to meet industrial requirements; it provides a basis for recovery of scrap, and gives each alloy a definite position.—H. S.

Discussion of the Papers by P. Blanchet and J. Douchement. (*Rev. Mét.*, 1937, 34, (9), 525–530).—See preceding abstracts. A useful discussion, in which a number of well-known French metallurgists took part.—H. S.

Instrumentation: Exact Science Combined with Fine Art. W. F. Behar and Richard Rimbach (*Metal Progress*, 1937, **32**, (4), 487–497, 501).—Descriptions of pyrometric control gear, and of the properties of the ideal machine for tensile testing, illustrate the requirements of modern physical and mechanical testing methods. It is expected that future advances will include the development of non-destructive testing methods, and of automatic inspection, examples of which are briefly discussed.—P. R.

Failures and the Testing of Welds. H. Wiegand (*Tech. Zent. prakt. Metallbearbeitung*, 1937, **47**, (11/12), 475–480).—Typical causes of failure are reviewed —inappropriate welding materials, slag inclusions, wrong type of flame, overheating, incomplete union in the weld, gas cavities, and internal burning of the metal. The various methods of examination and testing—visual, metallographic, X-rays, mechanical tests, magnetic and electro-magnetic—are discussed.—W. A. C. N.

"Form Strength" and Construction. A. Thum (*Jahrb. Lilienthal-Ges. Luftfahrt.*, **1936**, 75–93).—Mechanical tests on ordinary standard bars afford only an approximate guide to the behaviour in service of the variously-shaped members of a complex structure. Accurate measurement of the actual stresses and of their distribution, *e.g.* by optical methods, is practicable only in very simple cases, in which the "form coefficient" (ratio of maximum to nominal stress) has been evaluated. Knowledge of the "form strength" of members, *i.e.* their strength as compared with that of a standard bar of the same material, affords the only reliable basis for evaluating factors of safety: the variation in fatigue strength due to notching, threading, &c., in rod of the same material is shown diagrammatically. The influence of the amount and distribution of stress on the inception of flow and slip is discussed. The design of individual members should be influenced by the type of load and the stresses sustained in working, forming, and assembling. Modifications in design are suggested in some cases, and methods of forming and of stress-relief are considered in relation to economical construction. —P. R.

Application of Optical Methods of Stress Measurement in Aircraft Construction. G. Mesmer (*Jahrb. Lilienthal-Ges. Luftfahrt.*, **1936**, 147–153).—Stress distribution in the skin of aircraft structures can be studied in transparent models by means of an apparatus in which a reflector is inserted below the skin. The method is applicable to torsional and bending stresses as influenced by slots, &c., and to the effect of stiffening members.—P. R.

Stress Measurements. E. Siebel (*Jahrb. Lilienthal-Ges. Luftfahrt.*, **1936**, 265–277).—The distribution and magnitude of stresses may be determined mechanically by measurements of elongation or curvature, optically on transparent models, or by X-ray examination. Technique and apparatus are discussed in each case, and the advantages and limitations of the methods are reviewed.—P. R.

Metallic Damping. S. L. Roberton (*Metal Treatment*, 1937, **3**, (11), 138–142, 150).—The significance of measurements of damping capacity under stresses equal to the limiting fatigue-strength of a metal is discussed. Although materials with a high damping capacity often have a low notch-sensitivity in fatigue, it is pointed out that notch-sensitivity involves local strains considerably greater than those associated with the damping determinations. A recent method of measuring damping, of both bars and irregularly-shaped objects, by an electro-dynamic vibration apparatus is reviewed, and its application for the study of internal flaws and intercrystalline cracking discussed (see F. Förster, *Met. Abs.*, this vol., p. 460).—J. C. C.

A New Method for Investigating the State of Machined Surfaces [Tetameter]. H. Tornebohm (*Mécanique*, 1937, 21, (274), 207–209).—The Tetameter, an instrument for use in investigating and classifying the condition of machined surfaces, is described and illustrated. The pressure necessary in order to force a spherical die for a given distance into the material of the test-piece is measured and referred to a numerical scale of finish. The elastic limit of the material is not exceeded during the test, which thus differs materially from the Brinell test.—P. R.

The Life-Testing of Heat-Resisting Wire. Alex. M. C. Murphy (*Wire Ind.*, 1937, 4, (42), 277, 279, 281, 283; (43), 333–334, 337).—A description and critical review of tests that have been and are now used for the comparison of the life of resistance wires, with a discussion of the technical factors which influence the life. The fusion-comparison test, forced oxidation test, brine test, B.S. test, and Bash and Harsch test are discussed, and constant-wattage tests are mentioned. Reference is made to an accelerated test at relatively high temperature, using cycles of 2-min. heating and 2-min. cooling; the test, which determines the loss by scaling, is dismissed as in no way comparable with the treatment of the material in practice. M. shows the importance of control of manufacturing methods if regular life values are to be obtained. Purity of materials, alloying practice, hot- and cold-working methods, finish, annealing, and physical characteristics must all be strictly controlled. The different end-points that have been adopted in life-testing are discussed. The mechanism of failure by hot-spotting is considered, and is ascribed to intergranular formation of oxides. M. concludes that the time actually to burn-out should be accepted as the life. The A.S.T.M. test is criticized as unfair, if judged by variation of resistance, and also on the ground that the constant tension provision operates quite differently in the case of materials of different composition, and consequently of different mechanical and electrical characteristics; this contention is amply proved by results quoted from tests of nickel–chromium and of iron–aluminium–chromium alloys under the A.S.T.M. conditions, and under conditions modified as M. describes to meet his reasoned criticisms. He recommends as a true test, for heat-resisting properties alone, the use of a 4-in. specimen 0·020 in. diam., suspended vertically, and dipping freely into a mercury cup, and heated and cooled alternately for 2-minute intervals. Good results are also obtained if similar treatment is applied to specimens coiled in spirals of standard size and carried horizontally around refractory supports. With such testing methods, a rectilinear relation is found to connect log temperature (° C.) and log life (time in hrs.) for a given material; a diagram showing the variation in life with varying diameter of wire is also reproduced. M. concludes that the accelerated life test not merely affords a comparison of the efficiencies of different alloys, but that it also gives a very reasonable suggestion of their life when used under domestic conditions.
—W. E. A.

On Mechanical Methods of Evaluating Internal Stresses. F. Bollenrath (*Jahrb. Lilienthal-Ges. Luftfahrt.*, **1936**, 278–311).—Mechanical methods of determining the direction and magnitude of internal (residual) stresses are discussed and classified. They include tests on surface elements removed from the material under test, studies of the relief of stresses by drilling, &c., and mapping methods: in most cases the method either involves the destruction of the stressed object or is applicable only to sheet. The "drilling" method due to Mathar is recommended for large-scale work, and results obtained by its use in connection with quenched, welded, and riveted specimens are described, as are investigations on an experimental welded boiler. A *bibliography* is appended.—P. R.

New Aspects of Fatigue and Creep. John M. Lessels (*Metal Progress*, 1937, **32**, (3), 257–262).—A summary of two discussions, on the fatigue and creep of metals, respectively, held at the Massachusetts Institute of Technology, July, 1937. In addition to reports on testing methods, which included a description of apparatus for the simultaneous testing of a large number of specimens under identical conditions, the discussion dealt with problems of fatigue and creep arising from recent developments in a number of industrial fields, *e.g.* aircraft, railway construction, turbine design, and the oil industry.—P. R.

***A New Type of Machine for Fatigue Tests of Metals in Rotary Bending.** Marcel Prot (*Rev. Mét.*, 1937, **34**, (7), 440–442).—Describes a multi-spindle machine, each spindle being individually driven by a small electric motor. A new form of test-piece, designed for easy machining, is employed.—H. S.

***Testing of Bearing Metals and Bearings under Dynamic Stresses.** A. Thum and R. Strohauer (*Z.V.d.I.*, 1937, **81**, (43), 1245–1248).—An apparatus of the repeated-impact type is described, in which small cylinders can be tested at 1200 impacts/minute. The resistance to repeated-impact of Hoyt metal is six times as great as that of a lead–tin white metal with 50% tin. Two machines for testing bearings under repeated loading are also described.—v. G.

Simple Arrangement for Testing the Gliding Properties of Bearing Metals. —— (*Tech. Zent. prakt. Metallbearbeitung*, 1937, **47**, (11/12), 457).—A new apparatus is described for determining the comparative bearing properties of various metals and alloys, whereby results may be obtained more quickly than by many of the methods used previously. In essence, it consists in the controlled rotation of a 90° cone on a truncated 45° surface. Proper lubrication is provided and a thermometer is arranged to measure the temperature increase.—W. A. C. N.

***The Method of Thermal Autostabilization by Improved Rate of Elongation and the Establishment of Characteristic Diagrams of Flow.** Georges Ranque (*Rev. Mét.*, 1937, **34**, (6), 349–360).—The method consists in observing, as a function of time, the temperature which determines at each instant the permanence of length of a test-piece subjected to tension under steady load, the test-piece itself effecting the regulation by its variations in dilatation. Measurement of elongation as a function of time is indirect. A curve for variation of temperature as a function of time is observed : the dilatation of the specimen is known and, by changing the co-ordinates, another curve is obtained, indicating permanent changes of elongation as a function of time. The apparatus used and its applications are described. Results are discussed fully.—H. S.

Wear Testing. Donald S. Clark and Robert B. Freeman (*Metal Progress*, 1937, **32**, (1), 65–66).—In reply to correspondence on work by Freeman and by both authors (*Met. Abs.*, this vol., pp. 255, 406), C. and F. state that they do not consider the test previously described a method of comparing wear-resistance suitable for universal application.—P. R.

Elimination of the Influence of Thickness in Cupping Tests of Thin Sheets. —— Marchand (*Rev. Mét.*, 1937, **34**, (8), 472–474).—A special machine makes twelve ball-indentations of varying depth on the same sheet at the same time. The variation in Guillery number from one ball to another is obtained from the difference in projection of the balls from the face of the die-block in which they are held. Variation of Guillery number with thickness (T) shows that the former varies proportionally with a function of T of the form $T^{1/n}$, and, for values of T between 0·16 and 0·7 mm., n is nearly equal to 3. An "abac" having Guillery, thickness, and index scales covering the desired ranges, is used. Applications of the new machine for control of quality are described.—H. S.

Methods of Testing Sheet Metal for Deep-Drawing. L. Lindsberg (*Russko-Germanskiy Vestnick Nauki i Tehniki* (*Deut.-russ. Z. Wiss. Tech.*), **1936**, (11), 25–31 ; (12), 11–14).—[In Russian.] A review of the machines and methods of testing metal sheets for deep-drawing.—N. A.

***The Deep-Drawing Value of Brass Sheets according to the A.E.G. Testing Method.** G. Oehler (*Metallwirtschaft*, 1937, **16**, (42), 1059–1064).—In this method, round bowls of the metal are deep-drawn, and measurement is made of the diameter of the largest capable of being drawn without fracture. The apparatus is described, and the pressure on the plunger and the gripping force have been measured for various drawing conditions.—v. G.

Static and Dynamic Notch-Tensile Strength. E. Siebel (*Jahrb. Lilienthal-Ges. Luftfahrt.*, 1936, 383–396).—The methods and results of the notch-tensile test are compared with those of impact tests on notched specimens. The notch-tensile results are considered to represent more closely the conditions under which fracture occurs, and thus to be of the greater value to constructors, provided that the law of similarity applies in such cases.—P. R.

A Retrospect: Resilience. A. Cornu-Thenard (*Rev. Nickel*, 1937, **8**, (5), 131–134).—An historical review is given of the development of resilience tests, and the present position with regard to impact testing is briefly summarized. Bibliographic references are given.—P. R.

A Universal Press for Testing Materials. I. N. Bojok (*Mashinostroitel* (*Machine Builder*), **1937**, (8), 39–40).—[In Russian.] Describes the construction of a universal press for testing metals and building materials by compression, bending, and stretching.—N. A.

***On the Question of the Upper and Lower Yield-Point.** W. Späth (*Metallwirtschaft*, 1937, **16**, (28), 697–701).—The influence of the construction of the tensile machine on the shape of the load–elongation curve is discussed.—v. G.

***Influence of the Springing of the Machine on the Formation of the Yield-Point in the Tensile Test.** E. Siebel and S. Schwaigerer (*Metallwirtschaft*, 1937, **16**, (28), 701–702).—v. G.

***Differences in the Readings of Rebound Hardness-Testing Machines.** Walter Hengemühle and Erich Claus (*Stahl u. Eisen*, 1937, **57**, (23), 657–660).—Using standard steel specimens of different hardnesses, trials have been made with several classes of instrument, and with several heights of drop of the hammer in one type of instrument. The results were compared with a series of standard hardness tests, made with a Rockwell machine, on the same samples. It is shown that, under the conditions examined, there was considerable variation in the hardness results—the bands covering the figures in some cases not even embracing the standard curve. A comparison between the forms of the hammer tips, and an examination of the influence of the form and weight of the hammer tip, have been made.—W. A. C. N.

***Measurements with a New Scratch-Hardness Tester.** K. Sporkert (*Metallwirtschaft*, 1937, **16**, (34), 854–859).—The apparatus consists, in principle, of a microscope, in which the diamond pyramid with loading apparatus can be swung into the position of the illuminating apparatus. The scratch is then made by moving the stage of the microscope to which the specimen is clamped, the loading apparatus swung out and replaced by the illuminating apparatus, and the dimensions of the scratch measured without moving the specimen. Tests made on numerous materials show that the scratch produced has sharp edges even on the hardest constituents of an alloy, and its width can be accurately measured.—v. G.

Note on the File-Scratch Test. W. C. Hamilton (*Metal Progress*, 1937, **32**, (3), 265).—The method of carrying out file-scratch tests of surface hardness is briefly described, and appropriate drawing temperatures for a suitable series of files are indicated.—P. R.

British Standard Method and Tables for Brinell Hardness Testing. —— (*Brit. Stand. Inst.*, No. **240**, 1937, 24 pp.).—This standard, first issued in 1926, has been revised. The tables of hardness numbers, being derived from the accepted formula for Brinell hardness numbers, remain unaltered, but a number of amendments have been made in the requirements relating to the manner of carrying out the test.—S. G.

Recommendations for Leaded Gunmetals [Test-Pieces]. —— (*Met. Ind.* (*Lond.*), 1930, **50**, (20), 560, 568).—A letter from the Non-Ferrous Sub-Committee of the Technical Committee of the Institute of British Foundrymen, replying to Roast (*Met. Abs.*, this vol., p. 109). The " keel block " test-bar is thought to be impracticable, on account of its size and weight.—H. W. G. H.

RADIOLOGY.

Radiology in Testing. V. E. Pullin (*Met. Ind.* (*Lond.*), 1937, **50**, (19), 532).—Abridgment of a paper submitted to the International Association for Testing Materials. Three main applications in engineering are pointed out, viz. examination of castings of new design to indicate the need or desirability of modifications in design or technique, inspection of all types of metal structures, and X-ray crystal analysis.—H. W. G. H.

***The Cost of Non-Destructive Material Testing [by X-Rays].** W. E. Schmid (*Maschinenbau*, 1937, **16**, (19/20), 519–522).—With not too thick sheets, requiring a voltage of less than 100 kv., the cost of running the X-ray outfit for visual examination for flaws, &c., is R.M. 3.80 per hr. Photographs of finished structures cost R.M. 10–15 each. For thick objects, illumination with radium preparations is not only better, but cheaper, than with X-rays. Magnetic testing of small and medium-sized objects costs R.M. 2.00 per hr. —v. G.

The Present Position of the X-Ray Method of Measuring the Total Principal Stresses. F. Wever (*Jahrb. Lilienthal-Ges. Luftfahrt.*, **1936**, 312–319).—The principle of X-ray stress measurements is summarized, and the modified technique demanded by the Seemann–Bohlin focussing method is described. The accuracy of X-ray and mechanical methods, as applied in two instances, is compared graphically, and reference is made to the results obtained by X-ray investigations in the case of a large structure. A description is also given of the evaluation of stresses in welded and formed pieces, Duralumin tubing being used in the latter case.—P. R.

Determination of Individual Surface Stresses by X-Ray Methods. R. Glocker (*Jahrb. Lilienthal-Ges. Luftfahrt.*, **1936**, 320–333).—A method of determining surface stresses is described and illustrated. It is claimed that the method eliminates several sources of error, by rendering unnecessary the determination of the lattice constant of the unstressed pieces, and that it is applicable to the measurement of (*a*) the magnitude and direction of individual stresses, (*b*) the component in any direction of a given stress (not necessarily one of the principal stresses).—P. R.

X-Ray Methods of Studying Stress-Relief in Welds. John T. Norton (*Weld. J.* (*J. Amer. Weld. Soc.*), 1937, **16**, (10), Suppt., 19–22).—The X-ray diffraction method of studying the degree of distortion of metal crystals is described, the differences between the effects of plastic and elastic strain and of microscopic and macroscopic strain being pointed out. The application of the latest technique, using rotating samples and a microdensitometer, to a welded joint is described. The method is thought to have good prospects for practical use in the welding field, and possible lines of development are indicated.—H. W. G. H.

Practical Applications of X-rays for the Examination of Materials.—VIII–XII. W. G. Burgers (*Philips Tech. Rev.*, 1936, **1**, (12), 373–375; 1937, **2**, (1), 29–31; (3), 93–95; (5), 156–158; (8), 254–256).—Examples of the application of X-rays to the examination of materials are given, including: (1) the detection of macro-strains in an elastically flexed, cold-rolled nickel-iron strip; (2) demonstrating the effect of heat-treatment on the micro-strains in a steel ring; (3) revealing the difference between micro-strains in the surface layer and those in the core of a drawn tungsten wire; (4) the detection of the effects of heat-treatment on cold-worked metals; (5) judging the quality of nickel–iron strip for telephone loading coils; low hysteresis loss (a necessary property of loading-coil strip) is related in some way to a preferred orientation of the crystals; (6) estimating the quality of sheet or plates for drawing; (7) the detection of mechanical strains, mosaic crystals, and the amorphous state.—E. V. W.

†**X-Rays—What Should We Know About Them?** George L. Clark (*Elect. Eng.*, 1935, **54**, (1), 3–15).—A brief description of the nature and production of X-rays, and examples of typical applications in the radiological and crystallographic fields.—S. V. W.

A Five-Gramme Radium Unit, with Pneumatic Transference of Radium. L. G. Grimmett (*Brit. J. Radiology*, 1937, **10**, (110), 105–117).—A description of the new 5-grm. radium unit at the Radium Beam Therapy Research. Reference is made to the use of a heavy tungsten alloy for protection purposes.—S. V. W.

XII.—TEMPERATURE MEASUREMENT AND CONTROL

(Continued from pp. 544–545.)

Temperature Measurements in Molten Aluminium and Its Alloys. Kirtland Marsh (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 990–993).—S. G.

Insertion Pyrometers for Measuring Working Temperatures of Light Metals. F. Staneck (*Maschinenbau*, 1937, **16**, (19/20), 505–506).—The two wires of the couple are not welded together, but are insulated and inserted parallel into holes in the metal.—v. G.

Brass Foundry Temperature Measurements. Walter F. Graham (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1122–1124).—Discusses the necessity for temperature control, the effect of pouring temperature, methods of temperature measurement, and the standardization of pouring temperatures.—S. G.

Measurement of Temperature with Measuring Resistances. H. R. Eggers (*Z. Fernmeldetech.*, 1937, **18**, (4), 63–65).—A bridge circuit, in one arm of which is the measuring resistance (a resistance varying with temperature), is described; analysis shows that the deflecting force on the indicating instrument is independent of the out of balance of the bridge. Limiting values of the arm resistances are considered and special instruments appropriate to these conditions are described. A further circuit is indicated, by means of which the indicator scale can be widened at high temperatures.—R. T.

Measurement of High Temperatures. K. Guthman (*Arch. Wärmewirtsch.*, 1937, **15**, 49–52; *Sci. Abs.*, 1937, [B], **40**, 229).—An optical pyrometer is described which has been designed for the measurement of high temperatures in cases where uncertainty as to the emissivity renders the disappearing-filament pyrometer unsuitable. Light from the source enters a telescope, and passes through a bichromatic colour wedge and an adjustable neutral wedge. The former transmits complementary red and green colours and a yellowish-white field of variable intensity is obtained. The inclusion of a half-silvered mirror enables this to be compared with light from a lamp supplied by an adjustable current. The instrument measures both the colour temperature and a second temperature, which is close to the black-body temperature. From their difference, the emissivity, and thus the true temperature, can be derived. Observations made with this colour pyrometer are compared with those of thermocouples and disappearing-filament pyrometers, and a number of applications of the new instrument for the measurement of various industrial temperatures are described.—S. G.

Temperature—Measured and Controlled. R. R. Wiese (*Machinist* (*Eur. Edn.*), 1937, **81**, (40), 947–954).—The methods of temperature measurement, and particular applications of temperature control in the metal-working industry, are described.—J. H. W.

Methods and Apparatus for Measuring and Regulating Temperature. R. Boye (*Germanskaia Tehnika* (*Z. deut. Technik*), 1936, **15**, 10–11, 155–160).—[In Russian.] A description of industrial thermocouples and radiation pyrometers.—N. A.

Time Lag in a Control System.—II. D. R. Hartree, A. Porter, A. Callender, and A. B. Stevenson (*Proc. Roy. Soc.*, 1937, [A], **161**, (907), 460–476).—The previous theory (Callender, Hartree, and Porter, *Met. Abs.*, this vol., p. 59) is extended.—W. H.-R.

XIII.—FOUNDRY PRACTICE AND APPLIANCES

(Continued from pp. 545–548.)

***The Effect of Intensive Vibration on Metal Melting.** Gerhard Schmid and Lothar Ehret (*Z. Elektrochem.*, 1937, **43**, (11), 869–872).—By means of a magnetostrictive apparatus, a study was made of the effect of high intensity vibrations of 10 kHz frequency on some molten and freezing metals and alloys. A considerable refinement of the cast structure of antimony and cadmium took place, and the supercooling of antimony was prevented. These results do not agree with those of Sokoloff on zinc. In Duralumin, the cored structure was removed, and in Silumin the silica needles were broken up. It was found possible by this method to disperse lead in aluminium, and to modify Silumin by the addition of cadmium.—G. J. T.

***Influence of the Conditions of Solidification on the Structure of Ingots.** P. I. Baranov (*Zvetnye Metally* (*Non-Ferrous Metals*), **1936**, (7/8), 102–111; (9), 86–94).—[In Russian.] A study was made of the influence of pouring temperature, rates of cooling, mechanical stirring, and rates of pouring on the macrostructure of cast aluminium. Aluminium ingots (containing 0·1% iron and 0·23% silicon) were cast into an iron mould 240 mm. high and 60 mm. in diameter, with 30 mm. wall-thickness, at casting temperatures from 750° to 950° C. The outer zone of columnar crystals increases with increase in temperature and spreads through the body of the ingot. The same effect occurs with spherical ingots of 55 mm. diameter cast in thin-walled copper moulds. Both the columnar and the equiaxed crystals increase in size with increase in casting temperature. Spherical ingots (60 mm. diameter) cast in thin-walled iron moulds and cooled in different media show a decrease in thickness of the columnar zone with increase in thermal conductivity of the medium. If cooling takes place rapidly the columnar structure may disappear entirely. Grain-size increases with increase in rate of cooling. Ingots cast in moulds made of a kaolin–asbestos mixture exhibit an equiaxed structure throughout the ingot. Up to 250° C., the mould temperature does not affect the macrostructure of cylindrical ingots very greatly. Mechanical stirring during solidification results in considerable grain-refinement. Admixtures, especially mechanical impurities, increase the thickness of the columnar zone and the grain-size.—N. A.

***On the Rate of Melting.** (Tammann.) See p. 588.

***The Problem of Degassing and Refining of Metals and Alloys.** (Lepp.) See p. 588.

Wasters—Their Cause and Cure. IV.—Wasters Due to Runners and Risers. —— (*Iron Steel Ind.*, 1937, **11**, (1), 13–18).—See *Met. Abs.*, this vol., p. 355. The position of runners and various types of castings in relation to top and bottom pouring is discussed, and the type of runner used is considered. Consideration is also given to the necessity for risers, and the position, number, and type used with reference to particular castings.

—J. W. D.

Some Examples of the Influence of Conditions of Solidification of Aluminium Castings. R. Irmann (*Aluminium*, 1937, 19, (10), 635–639).—In making complex castings of aluminium alloys, those parts in which cooling is slow develop a very coarse macrostructure; this has not a very serious effect on the strength of the casting, but the resistance of these parts to fatigue-failure is relatively low. In castings in which a secondary agglomeration of the more fusible constituents takes place along the grain boundaries, the strength is considerably reduced: this occurs in some magnesium–copper aluminium alloys. Addition of small quantities of cerium or titanium considerably refines the grain-structure of the slowly-cooled parts, thus ensuring satisfactory strength and endurance, but in designing the patterns, sharp corners should be avoided, and no part should be made thicker than necessary to provide the performance required in use. In mass production work, the measurement of rate of cooling of the alloy in the solid state affords valuable information for dimensioning the sections and positioning the risers.—A. R. P.

Hardeners for Aluminium. H. O. Burrows (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 987–989).—The composition limits and properties of aluminium–copper, aluminium–silicon, aluminium–nickel, aluminium–manganese, aluminium–zinc, and aluminium–copper–zinc hardeners are given.—S. G.

Rules for Melting and Casting Aluminium and Its Alloys. —— (*Aluminium*, 1937, **19**, (10), 679–681).—Practical hints are given for obtaining good castings.—A. R. P.

Refining of Aluminium by Means of Nitrogen, Chlorine, and Mixtures Thereof. V. O. Gagen-Torn and M. B. Gohshtein (*Metallurg* (*Metallurgist*), **1937**, (3), 118–119).—[In Russian.] Passage of nitrogen through molten aluminium not only fails to purify it, but actually introduces new impurities. A nitrogen–chlorine mixture is beneficial, however, especially when it contains > 50% chlorine. Obviously, the effective gas is chlorine, and therefore dilution with nitrogen is unnecessary.—N. A.

Production of an Aluminium Container. E. Longden (*Met. Ind.* (*Lond.*), 1937, **51**, (15), 365–367).—The mould and core are made in greensand, the latter being required to yield to the metal contraction. Moulding equipment and technique are described for containers on a semi-production basis (not less than 10 castings). The casting is bottom-poured, the ingate feeding into a boss on the bottom of the container and being cut off, by a kind of slide valve, as soon as pouring is complete, in order to prevent the boss feeding down into the runner-gate.—H. W. G. H.

***Study of Y-Alloys.—I.–III.** Takeo Takeuchi (*Imono* (*J. Casting Inst. Japan*), 1937, **11**, (6), 377–388; (7), 449–460; (8), 544–551; and *Nippon Kogyokaishi* (*J. Min. Inst. Japan*), 1937, **53**, (623), 143–162).—[In Japanese.] An investigation to determine recommended practice for melting, casting, and heat-treatment of Y-alloys for castings and forgings. Sand- and die-castings were studied.—S. G.

***Chill-Casting of Special Silumin Castings.** J. A. Zenter (*Legkie Metally* (*Light Metals*), **1937**, (5/6), 12–17).—[In Russian.] The special Silumin alloy containing silicon 12, nickel 2·5, copper 0·9, and magnesium 1% has better casting properties than have other piston alloys; its use therefore results in a considerable decrease in the percentage of failures. The alloy should be cast at 670°–720° C. into moulds heated to 200°–250° C. The best heat-treatment consists in quenching in water from 525° C., followed by ageing at 150° C. for 18–24 hrs. The castings have a tensile strength of 29–30 kg./mm.^{2}, an elongation of 0·6–0·8%, and a Brinell hardness of 136–139.—D. N. S.

***Problem of the Modification of Silumin by Salts.** A. A. Botchvar and A. G. Spassky (*Zvetnye Metally* (*Non-Ferrous Metals*), **1936**, (10), 81–83).—[In Russian.] A study was made with a special Silumin containing cobalt 0·4, magnesium 0·25, and silicon 9–10%. It was found that this alloy could be satisfactorily modified by a 2:1 mixture of sodium fluoride and sodium chloride at 740°–790° C.—N. A.

The Problem of Porosity in Aluminium–Silicon Alloys. D. A. Petrov and K. S. Novikova (*Tehnika Vosdushnogo Flota* (*Tech. Air Fleet*), **1936**, (11), 80–85).—[In Russian.] The presence of sodium in Silumin increases the porosity of castings. Treatment with chlorine alone is useless, since the subsequent modification again induces porosity, and, if the treatment is applied after modification, the effects of this treatment disappear; chlorine also tends to remove magnesium. Treatment with nitrogen reduces the porosity of the modified alloy, but prolonged treatment nullifies the modification. Less porosity is obtained if the unmodified alloy is treated with chlorine, then modified with sodium, and finally treated with nitrogen, but the best results are obtained by modifying the alloy with a sodium chloride–fluoride flux. Silumin cannot be treated with zinc chloride.—N. A.

Dark Spots on Aluminium Alloy Castings. I. E. Tutov (*Metallurg* (*Metallurgist*), **1937**, (2), 93–100).—[In Russian.] Phosphorus is undesirable in light aluminium alloys, since it has a strong tendency to segregate; its amount should not exceed 0·02–0·025%. Phosphorus forms solid solutions or intermetallic compounds, both at the grain-boundaries and in the grains; the compounds are decomposed by water, with evolution of phosphine. Gas pores and an open structure caused by shrinkage during casting enhance the corrosion and facilitate the formation of dark spots in ingots containing phosphorus, since they permit access of water to the deeper parts of the ingot. Heat-treatment and washing with hot water to remove the nitre from salt-bath annealing operations also accelerate corrosion. Methods are discussed for preventing the formation of dark spots by controlling the phosphorus content at a low level.—N. A.

Light Alloy Chill-Castings. R. Irmann (*Werkstatt u. Betrieb*, **1937**, **70**, (21/22), 283–286).—Chill-castings in light alloys are preferred to sand-castings as regards the properties of the product and the economy of the process. Casting properties of 4 alloys are summarized graphically for pouring temperatures of 650°–800° C., and the composition and principal mechanical properties of 9 alloys, chill-cast and in some cases heat-treated, are tabulated.—P. R.

Hardeners for Copper and Copper Alloys. G. H. Clamer (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1118–1121).—Phosphor–copper, nickel–copper, manganese–copper, silicon–copper, and phosphor–tin hardeners are discussed. —S. G.

The Influence of Gases on the Formation of Pores in Casting Copper Alloys. E. Raub (*Mitt. Forschungsinst. Edelmetalle*, 1937, **11**, (1), 1–10).—See *Met. Abs.*, 1936, **3**, 170.—A. R. P.

***The Use of Beryllium in Copper-Base Alloys for Special Castings.** P. E. Rojkov (*Liteinoe Delo* (*Foundry Practice*), **1937**, (1), 23–31).—[In Russian.] High-quality castings of beryllium bronze can be obtained with similar moulding materials and casting methods to those used for ordinary tin-bronzes. Considerable segregation of beryllium occurs, especially in presence of aluminium. The average shrinkage in casting alloys with 1·5–2% beryllium is 1·5%. As little as 0·01–0·02% beryllium serves as a substitute for copper phosphide in the deoxidation of copper alloys. Mechanical and corrosion tests on cast and heat-treated alloys are described.—N. A.

Moulding a Marine Propeller with Hollow Blades. T. R. Harris (*Met. Ind.* (*Lond.*), 1937, **51**, (10), 225–226).—The propeller was made in four cores, the centre core forming the hole in the boss and the insides of the hollow blades. The pattern-making procedure is fully described.—H. W. G. H.

***Deoxidation of Brasses.** W. Broniewski and W. Lewandowski (*Prace Zakładu Metalurgicznego Politechniki Warsawskiej*, 1934, **4**, 71–84).—[In

Polish, with French summary.] See *Met. Abs.* (*J. Inst. Metals*), 1933, **53**, 521.—S. G.

Manufacturing Brass Parts for Hose Assemblies. L. A. Rowe (*Met. Ind.* (*N.Y.*), 1937, **35**, (9), 438–440).—An illustrated article, describing the processes in use at a large American foundry.—A. R. P.

***Researches on the Casting of Nickel Silvers.** M. Ballay and R. Chavy (*Bull. Assoc. Tech. Fonderie*, 1937, **11**, (3), 112–116).—See *Met. Abs.*, 1936, **3**, 413. —S. G.

How to Decrease the Proportion of Rejected Castings and to Improve the Quality of Magnesium Alloy Castings. A. S. Lugaskov (*Litenoie Delo* (*Foundry Practice*), **1936**, (11), 32–38).—[In Russian.] L. discusses casting defects (surface oxidation, slag and flux inclusions, gas-filled cavities) in magnesium alloys, and methods of overcoming them. A brief description is also given of general casting defects. The improvement of magnesium alloys by heat-treatment is dealt with.—N. A.

Manufacture of Graphited Babbitt. A. I. Shpagin and A. Z. Veselov (*Zvetnye Metally* (*Non-Ferrous Metals*), **1937**, (1), 74–87).—[In Russian.] Describes a recently-built industrial plant, with a capacity of 5 tons per day, for the production of graphited Babbitt. A *bibliography* of 28 references is appended.—N. A.

Investigation of Petroleum Fractions as Substitutes for Linseed Oil in the Manufacture of Cores for Casting Aluminium Alloys. E. M. Notkin (*Tehnika Vosdushnogo Flota* (*Tech. Air Fleet*), **1937**, (1), 86–92).—[In Russian.] As a substitute for pure linseed oil as a core-binder, a 1 : 1 mixture of this oil and "Local" (a petroleum fraction) is suggested. Cores prepared with this mixture are as strong as those made with pure linseed oil, have the same low hygroscopicity, and are easier to remove from the casting.—N. A.

Aluminium Die-Castings. G. M. Rollason and Sam Tour (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 994–999).—Discusses the scope and limitations, physical properties, machining, and finishing of aluminium die-castings and alloys, and the effects of impurities in alloys.—S. G.

How to Avoid Porosity in Special Silumin Castings by Casting Under Pressure. A. A. Botchvar and A. G. Spassky (*Aviopromishlennost* (*Aero. Ind.*), **1936**, (7), 5–11).—[In Russian.] Pressure castings of Silumin (silicon 7–10, magnesium 0·2–0·25, and cobalt 0·4–0·6%) up to 25 kg. in weight can be produced free from porosity and with all parts, even of complicated patterns, accurately reproduced. The pressure is applied 10–15 seconds after filling the mould, or 25–30 seconds after beginning to pour. Details are given of the method used in casting parts weighing up to 100 kg. in weight by this method; sections cut from these indicated better homogeneity, and better mechanical properties, than in similar gravity castings. With pressure-casting, more magnesium than usual can be added to the alloy to increase its mechanical stability; thus, addition 0·3% of magnesium to the above alloy increases its yield-point to 30–31 kg./mm.^{2}, with an elongation of 3%.—N. A.

†Counter Gravity Die-Casting of High Melting-Point Metals. Samuel P. Wetherill (*J. Franklin Inst.*, 1937, **224**, (2), 153–190).—A review of developments in the die-casting of metals and alloys with casting temperatures up to 3000° F. (1600° C.). For purposes of discussion the casting of cast-iron is dealt with, but it is stated that the principles can, with slight modifications, be applied to non-ferrous metals. Certain of the patents on the subject from 1906 to date are briefly reviewed. The timed removal of castings and the design, construction, and replacement of dies and the finished product are dealt with. Finally, the feasibility of automatic operation in mass-production is dealt with. A machine for this purpose has been developed, but the difficulty of supplying it with molten metal has still to be overcome. [*Note by Abstractor:* The developments referred to are confined mainly to those of the Wetherill Engineering Co., U.S.A.]—S. V. W.

Zinc[-Base Alloy] Die-Castings. W. M. Peirce and Marc Stern (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1349–1352).—Briefly discusses applications, design, alloys, physical properties, machining, and finishing.—S. G.

Zinc-Base Die-Casting Alloys. The Importance of Purity. H. L. Evans (*Die-Casting* (Suppt. to *Machinery* (*Lond.*)), **1937**, (Nov. 4), 6–7).—Brief notes are given on the importance of high-purity zinc for making die-casting alloys, and on the methods of its production.—J. C. C.

Rules for Constructing Magnesium Die-Cast Parts. W. Müller (*Metallwirtschaft*, 1937, **16**, (45), 1159–1163).—General rules are given.—v. G.

Pressure Die-Casting.—I. Hans Lawetsky (*Machinist* (*Eur. Edn.*), 1937, **81**, (40), 558–559E).—Practical points in die-casting zinc-, aluminium-, magnesium-, and copper-base alloys are summarized, and recent developments in die-casting machines are briefly described.—J. H. W.

Die-Casting. Arthur Street (*Metallurgia*, 1937, **17**, (97), 29–30).—Summary of a lecture to the Midland Metallurgical Societies (Birmingham Local Section of the Institute of Metals, &c.). Production methods in the manufacture of die-castings are described, and the gravity and pressure processes are compared. Attention is also given to the choice of suitable alloys and to the factors that contribute to their successful application.—J. W. D.

Die-Casting Stators and Rotors for Wireless Condensers. —— (*Die-Casting* (Suppt. to *Machinery* (*Lond.*)), **1937**, (Nov. 4), 1–3).—A description is given of the dies and casting methods used in the production of zinc-base variable air condenser units.—J. C. C.

Die-Casting—Operations on Die-Cast Parts. J. Gerber (*Tech. Zent. prakt. Metallbearbeitung*, 1937, **47**, (13/14), 542–544).—An example is given of the most efficient design of mould parts which will ensure that the finished products will conform to the standard pattern, and not show any variation in the vital dimensions.—W. A. C. N.

Die-Casting Definitions. —— (*Die-Casting* (Suppt. to *Machinery* (*Lond.*)), **1937**, (Nov. 4), 7–8).—J. C. C.

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

(Continued from p. 549.)

Proper Grading and Preparation of Non-Ferrous Scrap. H. T. Strang (*Canad. Mach.*, 1937, **48**, (10), 31–32).—General recommendations regarding the storage and classification of non-ferrous scrap are illustrated by special reference to copper and to turnings from red and from yellow brass.—P. R.

Protective Action of Beryllium in the Remelting of Magnesium Alloy Turnings. L. J. Shpoliansky (*Metallurg* (*Metallurgist*), **1937**, (2), 101–102).—[In Russian.] Magnesium alloy filings can be remelted with very small losses by burning (2–3%) and a flux consumption of 1% if only 0·05–0·25% beryllium is added to the charge.—N. A.

XV.—FURNACES AND FUELS

(Continued from pp. 549–551.)

Gas Heating of Melting-Pots and Casting Plant in Printing Works. —— Firmont (*Gas* (*Düsseldorf*), 1937, **9**, (7), 171–175).—Describes experience in the running of melting-pots and casting plant heated by surface combustion of towns' gas in Germany. The gas used in similar plant not employing the system of surface combustion is about 50% more.—J. S. G. T.

Gas Heating and Automatic Temperature Regulator for the Melting-Pots of [Type-]Setting Machines. Fritz Saalfeld (*Gas (Düsseldorf)*, 1937, 9, (4), 89–90).—Plant for melting type metal in gas-fired pots, and the temperature control effected by means of three types of thermostatic regulators, are described and illustrated.—J. S. G. T.

Application of Gas Radiant Tubes to Heating of Galvanizing Furnaces. A. M. Thurston (*Indust. Heating*, 1937, 4, (7), 550–553, 566).—From a paper read at the (U.S.) National Conference on Gas Sales. Heating is done by means of vertical gas radiants, the firing being from the top downwards, the reverse of the usual procedure. The flow of heat is delayed in the upper portions of the tubes by means of " core busters," thereby concentrating it in the upper third of the pot. Blast-type burners, using natural gas at 6 ozs./in.^{2} pressure, and air at 1 lb./in.^{2} pressure, are employed. Air and gas supplies are regulated by a temperature controller. Flame impingement is eliminated by this method of firing, the pot life being thereby increased materially.—W. N.

Operating Results Obtained with Small Gas-Heated Hardening Furnaces Having Automatic Temperature Regulation. G. Aigner (*Gas (Düsseldorf)*, 1937, 9, (7), 168–171).—Experience in the thermostatic control of gas-heated hardening furnaces, in which materials are heated for a few minutes only, is related. Control to within ± 5° C. is possible.—J. S. G. T.

Maintenance of Brine-Bath Furnaces. R. Harder (*Durferrit-Hausmitt.*, 1937, 6, (13), 145–152).—Defects likely to arise in service in crucible furnaces are described and illustrated, and methods of prevention and repair are discussed.—P. R.

Advantages of Air Circulation in Electric Furnaces for the Aluminium Industry. J. Eberwein (*Aluminium*, 1937, 19, (7), 452–455).—Air circulation in heat-treatment furnaces not only ensures a more regular and uniform heating of the sheets, but also increases the rate of heating; at 500° C. air circulation increases the temperature of the charge more than 5 times as quickly as direct radiation from the furnace walls using the same current input. —A. R. P.

Electrical Heating in the Light Metal Industry. Fr. Knoops (*Metall u. Erz*, 1937, 34, (17), 453–460).—Various types of electric furnaces for melting aluminium and its alloys are described and illustrated. Salt-bath and air-circulated heat-treatment furnaces are also discussed.—A. R. P.

Furnaces for the Heat-Treatment of Light Metals. Fredo Grahl (*Werkstatt u. Betrieb*, 1937, 70, (21/22), 301–303).—Salt-bath annealing furnaces, whether externally or internally heated, are generally used in the heat-treatment of light-alloy parts. Furnaces of both types are described and illustrated, and their approximate dimensions and power consumption indicated.—P. R.

An Electric Furnace for the Artificial Ageing of Light Alloys. I. Sidorov (*Aviopromishlennost (Aero. Ind.)*, 1937, (3), 68–69).—[In Russian.] The furnace will treat a charge of about 2½ tons. It is operated with 75 kw., and is provided with devices for maintaining the temperature constant to within ± 5° C. in the range 100°–300° C. Typical heating curves are given.—N. A.

Photoelectric Control of Resistance-Type Metal Heaters. E. H. Vedder and M. S. Evans (*Elect. Eng.*, 1935, 54, (6), 645–650; discussion, 1936, 55, (2), 189–190).—S. V. W.

†**The Development and Application of Electric Resistance Furnaces.** A. N. Otis (*Gen. Elect. Rev.*, 1936, 39, (12), 601–610).—The development of electric resistance furnaces during the last 20 years is dealt with, and illustrated by reference to typical types in use in the steel industry. The demand for improved quality at a lower cost has been largely met by improved design in electric furnace construction. All the well-known types of furnaces are dealt with, and, although most of the examples are taken from the steel industry, similar furnaces are in use in the non-ferrous industry. The high standard of

control which is possible with modern electric furnaces has resulted in improvements in all types of heating equipment.—S. V. W.

Electric Furnaces with a Graphite Radiator (Radiation Furnaces). Henri George (*Bull. Soc. franç. Élect.*, 1937, [v], 7, (80), 785–796).—Cf. *Met. Abs.*, 1935, 2, 254, 482. The 100-kg.-type of furnace is described in detail, and the results obtained and modifications made are discussed. The graphite radiators, if properly designed, can carry power up to 600 kw., and the graphite loss is less than that permitted in arc furnaces. Magnetic losses (equivalent to 100 kw. in a 500-kw. furnace) have been eliminated by using an encircling copper case as a return lead. The temperature obtainable is limited by the refractories, unless a centrifugal furnace, illustrated and described, is used. The extent to which these furnaces are now used is briefly reviewed.—R. T.

†**Industrial Electric Heating. XXII.—Inductive Heating.** N. R. Stansel (*Gen. Elect. Rev.*, 1936, 39, (9), 440–444).—A theoretical discussion of the process of heating by induction.—S. V. W.

Industrial Electric Heating. XXIII.—Transformers and Reactors for Three-Phase Arc Furnaces. N. R. Stansel (*Gen. Elect. Rev.*, 1937, 40, (5), 246–253).
—S. V. W.

The Grünewald Bright-Annealing Process. S. V. Williams (*Metal Treatment*, 1937, 3, (10), 55–59).—In the original Grünewald process, the charge is heated in a light pot sealed at the top with a water-cooled rubber ring, and fitted with a one-way valve to allow air and gases to escape. On cooling, a partial vacuum is developed. In the modified process, an artificial atmosphere is used either simply to purge the pot of air before heating, or to maintain a flow of gas. Applications of the process for bright-annealing various materials, including copper, phosphor bronze, and brass, are briefly described.—J. C. C.

The Heat-Treatment of Wire, Strip, and Their Manufactures. VI.—Annealing. Brass Strip Treatment. Thin-Walled Annealing Pots. —— (*Wire Ind.*, 1937, 4, (40), 173–175).—Brass strip in coils can be annealed in the ordinary chamber furnace, or in bell-type furnaces, but higher outputs may often be attained with furnaces such as the Siemens–Schuckert electric tunnel furnace, in which the strip is heated in a single layer only. The advantages of thin-walled annealing pots are stated and five types of such pots are illustrated and discussed.—W. E. A.

†**Electrothermal Processes.** J. W. Cuthbertson (*J. Inst. Elect. Eng.*, 1937, 80, (482), 211–217).—A review of progress during the past few years. Aspects of the subject referred to are: manufacture of pig iron; non-ferrous melting furnaces (other than induction types); low-frequency induction furnaces; high-frequency induction furnaces; and resistor furnaces for heat-treatment. Under the last heading, particular attention is devoted to bright-annealing processes and furnaces.—S. V. W.

XVI.—REFRACTORIES AND FURNACE MATERIALS

(Continued from pp. 551–553.)

Properties of Refractory Materials, Except Fireclay. Stuart M. Phelps (*Metal Progress*, 1937, 32, (4), 383).—A table. The chemical formula, approximate composition, and principal thermal and physical properties of 17 refractory materials are given, with some explanatory notes.—P. R.

Insulating Refractories. A. V. Leun. George A. Bole (*Refract. J.*, 1937, 13, (8), 506, 508–509).—A discussion held at the American Foundrymen's Convention. L. discusses the application of insulating refractories. Furnace wall thickness can be reduced by 50%, and fuel savings as high as 75% are possible; time for heating up can be reduced by 66%. The application of a face coating to the inner walls of the furnace is recommended; an air-setting, high-temperature cement of low shrinkage is suitable. B. discusses cellularity in insulating firebricks, and refers to the classification and specification of these refractories. Insulating firebricks have poor resistance to abrasion, and cannot be used in contact with slags.—J. S. G. T.

Basic Refractories. E. J. Crawley (*Refract. J.*, 1937, **13**, (7), 462).—Read before Rotherham Society of Engineers. Recent developments in the production and use of basic refractory materials are briefly reviewed. The spalling-resistance of basic refractory bricks has been considerably increased, so that very wide fields have been opened for the use of non-spalling chrome bricks. Amongst other uses, these chrome bricks are now used in copper-refining furnaces and converters.—J. S. G. T.

XVII.—HEAT-TREATMENT

(Continued from p. 553.)

Controlled-Atmosphere Annealing. E. C. J. Marsh (*Metallurgia*, 1937, **17**, (97), 25–27).—The practical difficulties which arise in operating a controlled-atmosphere annealing furnace are discussed. The type of work, and the general arrangement of the furnace and cooling sections, are first dealt with, and consideration is then given to the following factors which affect the finished product: cleanliness of the work with respect to extraneous contamination, by dirt, oil, grease, &c.; cleanliness of work with respect to oxide tarnish, rust, or corrosion products; composition of controlled gas atmosphere with respect to degree of control that can be instituted at the gas plant controls; quantity of controlled gas introduced at the various inlets; and air ingress with work or by other means.—J. W. D.

Annealing of Blanks in Electric Furnaces. Ulrich Schwedler (*Tech. Zent. prakt. Metallbearbeitung*, 1937, **47**, (13/14), 535–539).—Describes typical annealing furnaces, using controlled atmospheres. Bright-annealing, its effect in reducing the need for pickling, and its influence in producing superior blanks are discussed.—W. A. C. N.

The Application of Protective Atmospheres to the Bright-Annealing of Steel Sheets and Strip. A. G. Robiette (*Swansea Tech. Coll. Met. Soc. Paper*, **1937**, (Dec. 4), 1–14).—The theoretical aspect of the prevention of oxidation of metals is dealt with, and R. discusses the protective atmospheres that can be used in bright-annealing. Reasons are advanced for the necessity for maintaining certain ratios of the oxidizing to reducing, and carburizing to decarburizing elements in the gases. A brief reference is made to the types of furnaces used, and their applications are outlined. Diagrammatic and photographic illustrations are given of the batch- and continuous-types of furnaces.—R. Gr.

Controlled-Atmosphere Applications to Heating of Ferrous and Non-Ferrous Metals. T. B. Bechtel (*Wire and Wire Products*, 1936, **11**, (4), 183–186, 201).—Typical equipment used for bright-annealing is described, with particular reference to the treatment of ferrous materials. Brief mention is made of the use of continuous, controlled-atmosphere furnaces for brazing operations.—J. C. C.

Atmospheres and Furnaces in the Wire Industry. H. M. Heyn (*Wire and Wire Products*, 1936, **11**, (10), 507–520).—Brief reference only is made to the bright-annealing of non-ferrous metals. Typical equipment for the heat-treatment of ferrous materials is illustrated, and the physico-chemical reactions involved are discussed.—J. C. C.

The Heat-Treatment of Wire, Strip, and Their Manufactures. V.—Annealing. Annealing of Copper and Brass. —— (*Wire Ind.*, 1937, **4**, (39), 121–123).—Copper containing oxygen must in no circumstances be heated in a reducing atmosphere; such treatment results in "gassing." The older semi-muffle furnace, in which the flames and hot gases were admitted to the same chamber as the charge, has been superseded, for thicker gauges, by water-sealed furnaces with chain conveyors, in which the steam atmosphere prevents both gassing and scaling. Finer sizes are usually annealed in pots and protected from oxidation during cooling; a suitable pot is illustrated. Pot-annealing of brass is necessary to prevent excessive oxidation, but volatilization of zinc makes bright-annealing impossible. Flash-annealing yields wire of good finish and colour, but wire so annealed does not weave dead, and has no uniformity of structure; weaving wire should be fully annealed, and have the desired surface and colour developed by suitable cleaning after annealing.—W. E. A.

The Heat-Treatment of Wire, Strip, and Their Manufactures. VII.—Annealing. The Bright-Annealing of Non-Ferrous Wire and Strip. A. G. Robiette (*Wire Ind.*, 1937, 4, (41), 221–222, 225–226, 229).—A comprehensive review of the conditions necessary for the satisfactory bright-annealing of non-ferrous metals. The older wet method, using a steam atmosphere in continuous (Bates and Peard) or batch-type (Kenworthy) furnaces, involved water-quenching the charge and necessitated subsequent drying; impurities in the water frequently led to staining of the product, a source of especial difficulty in the case of spooled wire. This method is still in wide use for copper wire. A Continental system for avoiding the wetting of the charge used hydrogen to displace all steam from the container when the temperature had decreased to 200° or 300° C. The principles of dry-annealing in protective atmospheres are discussed: the greater the difficulty of reducing its oxide, or the higher the heat of formation of the latter, the less is the concentration of steam or of carbon dioxide which can be permitted over a metal at high temperatures. Impurities in the atmosphere may be important: in the case of nickel alloys sulphur causes embrittlement by intercrystalline penetration of nickel sulphide, and rapid deterioration of heating elements consisting of high-nickel alloys may occur for the same reason. Lubricants introduced with the charge may introduce sulphur or oxygen, or may decompose with deposition of carbon; prior degreasing may be too expensive, but suitably chosen lubricants may be volatilized and removed while the temperature is low. Sticking is more liable to occur with dry- than with wet-annealing; it is reduced by keeping both winding tension and annealing temperature as low as possible. The temperature of discharge of the furnace must be appropriate to the material treated. Burnt coal gas, burnt hydrocarbons, such as butane, and burnt or cracked ammonia provide suitable protective atmospheres, though cost may be a serious consideration; sulphur and water, respectively, may have to be removed. Types of furnaces in use are indicated, and the application of dry bright-annealing to copper, phosphor-bronze, brasses, nickel silvers with varying zinc content, nickel and nickel–copper alloys, and nickel–chromium alloys is discussed. Finally, economic factors are considered.—W. E. A.

***On the Question of Using Non-Scaling Steels for Nitrate Salt Baths [for Annealing Aluminium].** W. Geller (*Aluminium*, 1937, 19, (10), 647–648).—Nickel–chromium steel shows a loss of weight of less than 2% of that of wrought iron when used as a nitrate bath at 650° C.; the salt is coloured yellow but contains only 0·1% of chromate after 10 hrs. Heating the bath locally to 710° C. produces a vigorous oxidation of wrought iron which continues until the metal is perforated, whereas at 765° C. the special steel bath is very little more attacked than at 650° C. The use of this steel is recommended, therefore, since no scale accumulates on the bottom and thus there is little danger of overheating with perforation and possibly explosion.
—A. R. P.

Heat-Treatment of Wrought Aluminium Alloys. C. F. Nagel, Jr., and P. V. Faragher (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1003–1006).—Discusses the heat-treatment processes in use, and the general principles involved.—S. G.

***Cold-Working, Low-Temperature Heat-Treatment, and Annealing of Brasses.** W. Broniewski and T. Pełczyński (*Prace Zakładu Metalurgicznego Politechniki Warsawskiej*, 1934, 4, 17–45).—[In Polish, with French summary.] See *Met. Abs.*, 1934, 1, 264.—S. G.

***The Annealing of Standard Nickel Silver Alloys.** Arthur Gordon Dowson (*Abstracts Dissertations Univ. Cambridge*, **1936–1937**, 115).—Curves showing the relation between hardness and annealing temperature, and between grain-size, temperature of annealing, and amount of reduction (by cold-rolling) before annealing, have been obtained. The results are not given in the abstract.—A. G. D.

***Recovery of Cold-Worked Nickel by Annealing.** (Fetz.) See pp. 583 and 584.

***On the Effect of the Gas Atmosphere During Annealing on the Edge Structure and Bending Properties of Nickel Sheet.** (Winterhager.) See p. 584.

XVIII.—WORKING

(Continued from pp. 553–555.)

Method of Regulating the Grain Structure of Alloys and Objects Made of Them. Hans Hug (*Aluminium*, 1937, **19**, (10), 648–649).—The finished sheet or article is slightly cold-worked, and then scratch-brushed with a rotating steel brush; after recrystallization, the grain-size is remarkably uniform and much smaller than is ordinarily obtained. The process is illustrated by photomicrographs of aluminium sheet, cold-rolled to 6–10% reduction and then scratch-brushed, in parts only, before annealing.—A. R. P.

***A Study of the Deformation of the Macrostructure of Some Two-Phase Alloys by Cold-Rolling.** Hermann Unckel (*J. Inst. Metals*, 1937, **61**, 171–190; discussion, 190–196).—The deformation, on rolling, of alloys consisting of several phases having different yield-points, differs from that of alloys of homogeneous structure. Harder particles imbedded in a softer matrix deform less, and softer particles somewhat more, than the matrix. A secondary flow is thereby caused around the inclusions. Experiments with some two-phase alloys are described. It is shown that the deformation takes place in such a way that the work of deformation is a minimum.—H. U.

***Influence of High Rates of Rolling on the Mechanism of Deformation and Mechanical Properties of Metals.** P. S. Istomin, I. P. Zdesenko, and V. N. Petrova (*Zvetnye Metally* (*Non-Ferrous Metals*), **1937**, (3), 66–83).—[In Russian.] After annealing at 610° C. for 2 hrs., sheets (4 mm. thick) of 68·17 : 31·69 brass were cold-rolled into sheets or strip in 2-, 4-, and 6-high mills to 10, 35, 50, 80, and 90% reduction. The tensile strength, Erichsen value, microstructure, and X-ray structure were then determined. The results showed that the 6-high mill gives material of better mechanical properties, and more suitable for deep-drawing. A high rate of rolling still further improves these properties, but after high degrees of reduction the properties are better transverse to the direction of rolling than in this direction.—N. A.

***Resistance to Deformation in the Cold-Rolling of Non-Ferrous Metals and Alloys.** Ig. M. Pavlov and J. S. Gallay (*Metallurg* (*Metallurgist*), **1937**, (3), 62–78).—[In Russian.] The resistance to deformation of metals during rolling is given by the expression $p = P/B\sqrt{R(H - h)}$, where P is the pressure of the metal on the rolls, B is the width of the strip, R the radius of the rolls, and H and h the thickness of the strip before and after rolling. The value of p increases with increasing width of the strip up to 60 mm., but thereafter becomes practically constant. The absolute value of the deformation or of the elongation at a single pass does not affect p up to a total elongation of 2·5. For very thin and heavily deformed strips, p becomes, however, a function of the elongation; it increases with decreasing thickness of the strip, the equation $p = f(H)$ being a hyperbola. The dependence of p on thickness and on total elongation can be represented by the internal surface of a hyperbolic paraboloid. Lubrication causes a substantial decrease in p and in the number of passes required; in some cases both may be halved by the use of a suitable lubricant. The different lubricants may be arranged in increasing order of efficiency, thus: petrol, alkali, machine oil, castor oil. Curves are given showing the values of p in rolling copper, aluminium, Alclad, 62 : 38 and 68 : 32 brass, aluminium bronze, and iron–Tombac bimetal, with and without lubrication.—N. A.

Evaluation of the Economy of Rolling Mills. A. A. Bulgakov (*Metallurg* (*Metallurgist*), **1937**, (5), 109–113).—[In Russian.] A new concept of "technological capacity" is introduced, which permits a more exact characterization of technological standards of rolling-mill output, an evaluation of the possible output of rolling plants, and of the degree of their actual utilization.—N. A.

***Resistance of Alclad to Hot-Rolling.—I.** J. S. Gallay and N. N. Ge (*Metallurg* (*Metallurgist*), **1937**, (4), 115–121).—[In Russian.] In the rolling of aluminium-clad VV 1 alloy (copper 4·93, magnesium 0·68, manganese 0·97, silicon 0·43, iron 0·49, titanium 0·06%) heating of the rolls to 100° C. and lubricating them with wax has no effect on the specific resistance of the material to deformation. The width of the strip is also without influence if it exceeds 80 mm. The temperature of the material at the beginning of rolling must not exceed 450° C. The resistance to rolling is 19 kg./mm.^{2} at 425° C., and 34 kg./mm.^{2} at 350° C.; it varies with the temperature according to the expression $p = 19 + (425 - T)/6$. With increasing total deformation, the mean resistance for a pass increases, *i.e.* the thinner the strip the greater is its resistance. The resistance is a hyperbolic function of the thickness of the strip.—N. A.

Ingotless Rolling of Brass [Direct Rolling from Liquid State] in the "Kransy Vyborshez" Works. S. D. Brilkin (*Zvetnye Metally* (*Non-Ferrous Metals*), **1936**, (10), 83–99).—[In Russian.] A detailed description is given of the method of direct rolling of liquid brass, as developed in Leningrad. The thickness and structure of the resulting strip are under control. The properties of the product depend essentially on the casting conditions, *e.g.* freedom from impurities, scale, &c. Experiments on copper, aluminium, and aluminium bronze indicate the possibility of finding appropriate conditions for the direct rolling of these metals also. The process can be applied to alloys which are unsuitable for hot-rolling by the usual method. The quality of products obtained by direct rolling is not inferior to that of those produced normally, and the process is much more economical.—N. A.

Metal Rolling Without Ingots [Direct Rolling from the Liquid State]. I. G. Kulbachny (*Teoria i Praktika Metallurgii* (*Theory and Practice of Metallurgy*), **1937**, (3), 46–54).—[In Russian.] A review, dealing with the Hazelett process (Brit. Patent 421,539, Dec. 17, 1934), in which a furnace is tilted to supply a pool of molten metal between rolls.—N. A.

How We Tackled the Problem of Rolling Without Ingots [Production of Brass Strip]. S. D. Brilkin (*Teoria i Praktika Metallurgii* (*Theory and Practice of Metallurgy*), **1937**, (5), 55–59).—[In Russian.] See also preceding abstracts. A description is given of a mill, which has a constant pressure on the rolls and which is used for the production of brass strip.—N. A.

On Rolling-Mill Bearings. Wilhelm Rohn (*Z. Metallkunde*, 1937, **29**, (8), 261–262).—Substitution of bronze bearings in rolling-mills by needle bearings results in a 50% reduction in power consumption and a 33% reduction in the number of passes required to produce a given degree of reduction.—A. R. P.

Bearings for Rolling Mills in Non-Ferrous Metal Works and the Use-Prohibition for All Base Metals. L. Weiss (*Metallwirtschaft*, 1937, **16**, (35), 879–884).—Synthetic materials can be used as bearings in wire-rolling mills, as the pressure on the bushings does not exceed 60 kg./cm.^{2}. This pressure in cold strip-rolling mills may be as high as 300 kg./cm.^{2}, and, since the coeff. of friction may reach 0·05, considerable frictional heat must be dispersed; in this case, and in hot-rolling synthetic material, such bearings can be used only in carefully-designed new seatings. Tables and expressions are given for calculating the rolling pressure and the load on the bearings under various conditions.—v. G.

The Application of Nomographs in Tube-Rolling Mills. Rudolf Mooshake (*Stahl u. Eisen*, 1937, **57**, (23), 649–655).—A discussion of the construction of a nomogram for calculating the weight of the initial ingot from the outer diameter, wall-thickness, and length of the tube. A nomogram is also established for obtaining the hollow ingot length and the gaps of Pilger rolls. Examples are given involving the use of these nomograms.—W. A. C. N.

Extruded Tubes and Round and Profiled Rods of Non-Ferrous Metals. E. Trebesius (*Aluminium*, 1937, **19**, (7), 475–477).—A brief review of modern methods of extruding rods and tubes, and making small pressed parts, of non-ferrous metals.—A. R. P.

Direct and Indirect Extrusion Methods for Aluminium and Its Alloys. A. von Zeerleder (*Aluminium*, 1937, **19**, (10), 634).—Indirect extrusion has the disadvantages that: the design of the press is much more complicated, the plunger has a tendency to weaken in use, the area of the section extruded is limited, and the material undergoes a smaller amount of deformation, which has a deleterious effect on the extruded product.—A. R. P.

Comparison of Power Requirements in the Extrusion of Capsules of Pure Aluminium and Various Aluminium Alloys. A. von Zeerleder and E. von Berg (*Schweiz. Arch. angew. Wiss. Tech.*, 1937, **3**, (5), 109–112).—At room temperature, the power requirements follow an almost linear law; at higher temperatures, the power consumption varies proportionally with the temperature. The necessary pressure for pure aluminium at 250° C. is about 60% less than that at 20° C.; for Anticorodal the figure is 45%, and for Avional 30%.—W. A. C. N.

The Impact-Extrusion of Aluminium. E. Herrmann (*Tech. Zent. prakt. Metallbearbeitung*, 1937, **47**, (13/14), 528–532).—In this process a disc of aluminium or aluminium alloy, 4–5 mm. thick, is placed in a sunken matrix, and is subjected to the blow of a falling die, whereby the metal is induced to flow between die and matrix in the form of a tube with one end closed. Pressures in excess of 100 kg./mm.^{2} are used. Vaseline or heavy machine oil is used as lubricant. Circular and polygonal discs may be employed. With certain alloys, the discs may be heated to 150°–200° C. before being placed in the matrix.—W. A. C. N.

Metal Flow in Tube Extrusion. Clement Blazey (*Met. Ind.* (*Lond.*), 1937, **51**, (15), 353–356).—The extrusion of copper and copper-alloy tubing is considered to take place in five stages, which are described. To investigate the manner in which the metal flows under the action of mandrel and plunger, three methods of examination are used: (1) marks are stamped on the outside of brass billets, and their positions noted at the end of the extrusion; (2) the process is stopped at various stages, and the partly extruded billets are sectioned and etched to develop grain structure; (3) composite billets are prepared, and examined at successive stages of extrusion. The results of the three methods agree fairly well, and show that the mode of flow is essentially similar to that obtaining in rod extrusion by the direct method.—H. W. G. H.

***Causes of Skin Formation on the Extrusion of LS 59 Brass Rods.** V. A. Kochkin (*Metallurg* (*Metallurgist*), **1937**, (3), 104–111).—[In Russian.] The flow of LS 59 brass from the container in the extrusion process, with and without a "sleeve," takes place according to the scheme suggested by Schweissgut. If no sleeve is used, scale is invariably formed in the centre of the rod. To avoid defects, the residue left in the container should have a thickness equal to the diameter of the container. When a sleeve is used, the amount of residue can be reduced considerably. If the surface of the die and the upper surface of the ingot are kept thoroughly clean, a riffled die has no advantage over a flat one. The best extrusion temperature for LS 59 is 690°–750° C.—N. A.

***Investigation of Copper Alloys for Thin-Walled Tubes.** A. S. Ball (*Zvetnye Metally* (*Non-Ferrous Metals*), **1937**, (2), 87–102).—[In Russian.] The alloys studied contained: (*a*) manganese 1·93 or 1·75%, (*b*) lithium traces or 0·006%, (*c*) silicon 0·5 or 0·75%, (*d*) zinc 1·48 or 1·88%, and (*e*) beryllium 0·097 or 0·13%. 90 kg. of each alloy were melted in one charge, and the mechanical properties of the cast ingot investigated. The ingots were then extruded into tubes, which were drawn down and shaped in various ways: the products were then annealed, and their mechanical properties, tendency to season-cracking in ammonia vapour, and resistance to corrosion by sea-water and by moist air determined. The best results were obtained with the alloys containing manganese, which had a tensile strength of 22 kg./mm.^{2}, an elongation of 38%, and a Brinell hardness of 58, and were not affected by ammonia vapour. —N. A.

Continuous Extrusion of Lead Cable-Sheaths. P. Dunsheath (*J. Inst. Elect. Eng.*, 1937, **80**, 357–367; discussion, 367–377; and *Wire Ind.*, 1937, **4**, (37), 37, 39–41; (38), 95; (39), 147–149, 151, 153; also (summary) *Mech. World*, 1937, **101**, (2612), 77–78; (2613), 109–110).—D. deals primarily with a new development in methods of producing lead cable-sheaths, in which the pressure required to extrude the lead is obtained by means of a motor-driven screw member, instead of by the ram of a hydraulic press—hitherto universal practice. After a detailed review of the disadvantages of former methods, D. describes the construction and operation of the continuous lead-extrusion machine, and, from considerations of the physical and metallurgical properties of the sheath, demonstrates the improvements in the product achieved. As the advantages of the use of the continuous lead-extrusion machine are associated to some extent with the methods employed in melting the lead, and in handling the cable as it comes from the machine, special attention has been given to these features during the development of the machine itself. Improved lead-handling and -melting equipment and automatic reeling mechanism for the finished cable are described.—S. G.

Zinc Parts Produced by Impact-Extrusion. Herbert Chase (*Met. Ind.* (*Lond.*), 1937, **51**, (10), 223–224).—High-purity zinc is sufficiently ductile for impact-extrusion, in which a slug, placed in a die recess, is struck by a punch of smaller diameter than the recess, the metal being extruded through the annular space between punch and die, to form the side walls of the piece. Accuracy and finish compare with those of drawn parts, and are much superior to those of forgings. Products, varying in dimensions from 0·437 in. diam. by 2·5 in. high to 2·125 in. diam. by 8 in. high, have been produced. —H. W. G. H.

***The Effort of Drawing in the Manufacture of Non-Ferrous Alloy Tubes.** V. A. Kochkin (*Metallurg* (*Metallurgist*), **1937**, (5), 95–108).—[In Russian.] The theoretical bases of the drawing process apply both to tubes and rods. The existence of the friction between the tube and the mandrel complicates the expression for the drawing effort in the case of tubes. Weiss' expression for calculating the drawing effort for tubes is incorrect, since the surfaces subjected to friction between the tube and the die and between the tube and the mandrel are considered to be equal. A simple logarithmic expression, which represents approximately the effort required for tube drawing, is proposed. The optimum die angle for drawing tubes of all sizes and materials is 8°–10° for ordinary degrees of reduction. The tensile force on the bolt(?) becomes smaller with decrease in die angle. The drawing effort is proportional to the reduction in cross-section and to the degree of previous reduction, and is directly dependent on the tensile strength of the tube.—N. A.

***Calculation of Drawing Effort, Taking into Consideration the Change in the Surface of the Specimen by Plastic Deformation.** V. V. Zverev (*Zvetnye Metally* (*Non-Ferrous Metals*), 1937, (4), 90–100).—[In Russian.] To the differential equation expressing the energy balance in the deformation of a metal in the die orifice, a new term is added to take into account the change in the surface of the metal produced by deformation. The expression obtained for the drawing effort in this way indicates that the effort is a minimum at a definite die angle. A similar expression can be derived for the drawing of specimens in the tensile strength test.—N. A.

Hot- and Cold-Working of Copper Alloys. R. S. Pratt (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1125–1129).—A review, with 8 *references*. Tables are given classifying various copper alloys and compositions as regards their capacity for different hot- and cold-working operations.—S. G.

***On the Theory of Metallo-Ceramic Processes. I.—On the Theory of Sintering.** M. J. Balshin (*Vestnik Metallopromishlennosti* (*Messenger Metal Ind.*), 1936, **16**, (17), 87–120).—[In Russian.] Existing theories of the sintering of metallic powders are discussed. In the recrystallization of compact metals, the new crystallites can grow only into the space formerly occupied by the old ones, whereas in the recrystallization of pressed powders, growth can also take place into the pores between the particles. Density changes during sintering are considered to be due to two kinds of forces, one tending to press the particles together and the other to separate them. The former type prevail in the looser structures, and the latter in the more compactly pressed powders. Measurements are recorded of the effect of sintering in hydrogen on the volume and linear dimensions of cubes pressed from copper and iron powders (grain-size 10^{-3} — 10^{-6} cm.), apparent *d* 0·46–4·57 and 0·67–3·7, respectively. A study was made of the influence of: size and shape of the original particles; presence of impurities; degree of compression; temperature and duration of sintering; hardening by cold-working; and annealing of powders before pressing. Comparison of the shrinkage of powders with different apparent densities shows that the degree of compression is a more important factor than the absolute value of the pressure used. The shrinkage is greater in the direction of pressing than transverse thereto, this effect being more marked with copper than with iron. The looser the powder, the greater is the shrinkage on sintering. Compact powders increase in volume on sintering. Increase in temperature and in duration of sintering increases the shrinkage of loose powders and decreases that of the more compact ones. Addition of graphite decreases the shrinkage of copper. The results can be explained by B.'s theory, without taking into consideration secondary effects, *e.g.* those due to adsorbed gases or oxide films, although the possible influence of these effects is not denied.—D. N. S.

On the Theory of Metallo-Ceramic Processes. II.—Special Methods for Investigating the Technology of Metallo-Ceramic Processes. M. J. Balshin (*Vestnik Metallopromishlennosti* (*Messenger Metal Ind.*), 1936, **16**, (18), 82–90).—[In Russian.] The insufficiency of metallographic methods for the characterization of metal powders is stressed, and suggestions are made for special methods based on the results obtained in Part I of the paper (preceding abstract). Conclusions regarding the shape of the particles can be reached, for example, from the anisotropy in the properties (compressibility, hardness) of pressed powders. The change in apparent density of powders by pressure permits a distinction to be drawn between "hard" and "soft" powders. Copper and iron show an increase in apparent density by pressure and are therefore both classified as "soft" powders, whereas tungsten shows a decrease in density by pressure. The change in density by annealing (in the non-pressed as well as the pressed state) characterizes the recrystallization-capacity of powders, and is therefore important for the determination of the value of different powders for metallo-ceramic purposes.—D. N. S.

***On the Theory of Metallo-Ceramic Processes. III.—Principles of the Rational Preparation of the Mixture and the Problem of Cementation.** M. J. Balshin (*Vestnick Metallopromishlennosti* (*Messenger Metal Ind.*), 1936, **16**, (18), 91–99).—[In Russian.] See also preceding abstracts. In the sintering of mixed powders prepared from reduced iron (apparent density 0·67 grm./c.c.) and electrolytic iron (2·11 grm./c.c.), the shrinkage is found to be an additive property. The mechanical properties of the sintered product are improved by addition of the finer powder, which acts as a "cement" between the larger particles.—D. N. S.

The History of Wire: Further Researches. Ernest A. Smith (*Wire Ind.*, 1937, **4**, (42), 263–264, 267).—Historical.—W. E. A.

Wire-Drawing. F. C. Thompson (*J. B'ham. Met. Soc.*, 1937, **17**, (3), 106–124; also (slightly reduced) *Met. Ind.* (*Lond.*), 1937, **51**, (15), 357–360, and *Metallurgia*, 1937, **16**, (96), 212–213).—Contrary to the conclusions of mathematical analysis, it has been shown experimentally that the power required to draw wire is not proportional to the logarithm of the ratio of the original and final areas, but is directly proportional to the elastic limit of the material to be drawn, the speed of drawing, and a factor depending on the area. The angle and contour of the die, the temperature at which reduction is actually effected, the coeff. of friction between wire and die, and the space lattice of the metal being drawn, are also important factors. Except at low speeds, the pull required is independent of the speed of drawing. Using carbide dies, the minimum tension is required with a semi-angle of about 5½°–6°. Lubrication is of the boundary type, and additions of fatty acid to the oil used reduce the friction. A useful picture of the flow of metal, in the drawing process, is given by the Hele Shaw apparatus.—H. W. G. H.

Plastic Deformation in Wire-Drawing. B. L. McCarthy (*Wire and Wire Products*, 1936, **11**, (10), 493–500).—The drawing of steel wires alone is considered. Emphasis is laid on the importance of a uniform distribution of the cold-working strains, and hence, when drawing duplex alloys, of as finely-dispersed a structure as possible in the material.—J. C. C.

Lubrication in Wire-Drawing. R. Goodacre (*Inst. Mech. Eng., General Discuss. on Lubricants, Advance Copy*, **1937**, (Group III), 61–67).—The equations of Gwecke, Sachs, and Lewis are briefly reviewed. These equations relate the power required for drawing with the die dimensions, reductions, and yield-point of the metal drawn. The views of Francis, Lewis, and others with regard to the rôle of the lubricant in drawing are referred to briefly. Explanations are presented to account for the action of a lubricant. The view of various workers is that an adsorbed film of lubricant exists on the surface of metals in contact. The relation of chemical groupings to the efficiency of lubrication is indicated, and related to drawing operations. Consideration is given to the unique position of soap as a universal lubricant in dry-drawing, which should, on theoretical grounds, possess only moderate lubricating properties. Wet-drawing is dealt with and includes the use of copper, tin, and lead for this purpose. Possible future developments are only briefly indicated, and reference in this connection is made to the introduction of the synthetic die. A *bibliography* of 18 references is appended.
—R. Gr.

Lubrication in Wire-Drawing. F. C. Thompson (*Inst. Mech. Eng., General Discuss. on Lubricants, Advance Copy*, 1937, (Group III), 148–156; and *Met. Ind.* (*Lond.*), 1937, **51**, (17), 409–411).—The necessity for lubrication in wire-drawing is briefly explained: experimental facts are summarized to explain the nature of the lubricant film. Evidences of "boundary" lubrication are stated. The tenacious film of soap left on wire after drawing is stated to be in agreement with boundary lubrication, in that an adsorbed film is anchored to the metallic surface. The necessity for cooling the dies in drawing is questioned. Breakdown of the lubricant sets the upper limit of temperature of drawing. The uses of different lubricants for dry- and wet-drawing are considered. An inefficient, or moderately efficient, lubricant such as water should be used where a bright-surfaced wire is required for subsequent coating.—R. Gr.

Aluminium Wire. Its Manufacture and Uses. R. T. Griebling (*Wire and Wire Products*, 1936, **11**, (2), 69–71, 106).—A brief account of modern practice in the production of round, flattened, and square wire from aluminium and its alloys. Some properties and uses of these products are enumerated.—J. C.

Power for Cascade-Drawing of Copper. Paul M. Mueller (*Wire and Wire Products*, 1936, **11**, (10), 503–505).—See *Met. Abs.*, 1936, **3**, 589.—S. G.

New Double-Pointed Vertically-Cast Wire-Bar. Frederic Benard (*Wire and Wire Products*, 1937, **12**, (9), 491, 495).—See *Met. Abs.*, this vol., p. 464. —S. G.

Production of New Copper-Clad Cable. —— (*Met. Ind.* (*Lond.*), 1937, **51**, (18), 425–426).—The Pyrotenax cable consists of single or multi-conductors, insulated from each other and from the sheath of drawn copper tubing, by highly compressed anhydrous magnesia. Details of the manufacturing process, and tests of fireproof and mechanical properties, are described.—H. G. H.

The Calculation of Wire Drafts and the Use of the Slide Rule in the Wire-Mill. Tom Gore, Jr. (*Wire and Wire Products*, 1936, **11**, (4), 173–175).—Elementary.—J. C. C.

Wire-Mill Drafting Tables. Tom Gore, Jr. (*Wire and Wire Products*, 1936, **11**, (5), 221–224).—Series of die diameters are tabulated for reductions of area of 40, 35, 33, 30, 27½, 25, 22½, 20, and 15% per pass, respectively.—J. C. C.

Cleaning Houses in the Wire Industry. A. F. Anjeskey (*Wire and Wire Products*, 1936, **11**, (10), 570–571, 574–575, 603).—Economies in handling costs and floor-space can be secured by arranging pickling and washing tanks in a straight line, rather than on the old circular plan. Details are given of the construction, equipment, and operation of some modern (ferrous) pickling plants.—J. C. C.

Tungsten Carbide and Its Application to Dies and Tools. A. R. Zapp (*Wire and Wire Products*, 1936, **11**, (10), 566–568).—Sintered tungsten carbide is usually made in either hard or tough grades containing 6 and 13% cobalt as a binder, respectively. Recent improvements, involving careful selection of raw material and closer control of particle size, moulding pressures, and sintering technique have resulted in a higher density and greater strength, whilst additions of tantalum and titanium carbides have been made to obtain special characteristics.—J. C. C.

Some Recent Developments in Tungsten-Die Practice. James R. Longwell (*Wire and Wire Products*, 1936, **11**, (2), 72–75, 100).—The selection of nib sizes to secure lowest die costs in a wire-drawing plant, by avoiding the accumulation of worn dies which are not needed for larger wire, is discussed. Reference is made to the use of tungsten carbides for drawing and sizing dies for sheet metal, burnishing dies in the nut and bolt industry, and upsetting punches and header dies.—J. C. C.

A Method of Handling Tungsten Carbide Dies Within the Die Room. K. R. Beardslee (*Wire and Wire Products*, 1936, **11**, (10), 553–559).—A detailed illustrated account is given of the methods of lapping, polishing, and recutting tungsten carbide wire-drawing dies. A lapping machine and an automatic polisher are used for dies $\frac{1}{4}$ in. and less in diameter. Larger dies are bored with a diamond tool on a precision bench lathe. Recommendations are made for the routine to be followed in the die room.—J. C. C.

Cold- and Hot-Forming Aluminium Alloys. C. F. Nagel, Jr., and P. V. Faragher (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1000–1002).—A brief review.—S. G.

Plastic Shaping of Light Metals. O. Gaats (*Maschinenbau*, 1937, **16**, (19/20), 499–502).—Suitable methods and apparatus for working light metal sheets by bending, deep-drawing, &c., are described.—v. G.

Forming of Magnesium. H. Menking (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1218–1219).—A review.—S. G.

***Characterization Tests of the Forgeability of Metals and Alloys.** A. Portevin, E. Pretet, and J. de Lacombe (*Ann. Acad. Sci. Tech. Varsovie*, 1935, **2**, 167–198).—There is a close relationship between the forgeability of metals and alloys and their mechanical properties at high temperatures. Measurements have been made of several such properties—including torsion, compression, bending, and tensile tests—of ferrous and non-ferrous alloys at different temperatures. The speed of testing is important, and similar results are obtained by the different methods, which may provide useful information about the optimum conditions for forging operations. The principles involved in the problems are discussed, and, with these in mind, a machine has been designed for carrying out bending tests on notched specimens in different atmospheres. A *bibliography* of 49 references is given.—N. S.

The Forging of Light Alloys. A. v. Zeerleder (*Werkstatt u. Betrieb*, 1937, **70**, (19/20), 270–272).—The forging temperature, strength (soft-annealed), and approximate composition of 2 grades of aluminium, 5 light alloys, high-grade copper, α–β brass, and a soft iron are tabulated, and the relation between forging pressure and temperature is shown graphically in each case. Methods of preparation and suitable heating conditions are described.—P. R.

The Drop-Forging of Light Alloys. Bernhard Preuss (*Werkstatt u. Betrieb*, 1937, **70**, (19/20), 272–274).—Free forging and drop-forging are compared in respect of economy and speed, the respective sequences of operations being illustrated and a time analysis given.—P. R.

Forging of Manganese–Bronze. I. T. Kolenov (*Zvetnye Metally* (*Non-Ferrous Metals*), **1936**, (10), 104–107).—[In Russian.] The forging of manganese–bronze containing copper 55·3, zinc 39·5, manganese 4·35, iron 0·85%, and not more than 0·04% impurities should be carried out at 780°–650° C. The best mechanical properties and structure are obtained with a final forging temperature of 650° C., a deformation coeff. of not less than 4, and a reduction of 70%.—N. A.

Forging Monel Metal, Nickel, and Inconel. F. P. Huston (*Drop Forger*, 1937, **16**, (4), 290–300, 302, 304, 306, 308).—See *Met. Abs.*, this vol., p. 262. —S. G.

Influence of Surface Condition on the Locking Forces in Contact Fittings. Otto Kienzle (*Mécanique*, 1937, **21**, (274), 203–206).—Read before the Société Française des Mécaniciens. Methods of fitting, which are limited to the use of annular fittings on a simple cylinder, are classified according to the direction of the locking stress and the method of assembly. The importance of the degree of finish and of the direction of machining is emphasized, with illustrations, and the factors which influence the behaviour of "longitudinal" and "transverse" fittings in close contact are summarized.—P. R.

A Contribution to the Study of the Influence of Surface Condition on Contact Fittings. P. Nicolau (*Mécanique*, 1937, **21**, (274), 214–216).—Cf. preceding abstract. A micrometer method for investigating the surface finish of metal specimens is described and illustrated. The mutual influence of the method of fitting and the surface condition of the material is illustrated by a tabulated summary of results obtained on 10 shafts with sleeve fittings, the torsional couple necessary to fit and to remove the sleeve being given in each case.—P. R.

Machining Aluminium and Aluminium Alloys. R. L. Templin (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1007–1011).—Deals with lathe tools, planer and shaper tools, milling cutters, threading tools, twist-drills, reamers, saws, files, grinding wheels, tungsten carbide tools, cutting feeds and speeds, and cutting lubricants.—S. G.

Advances in the Working of Light Metals Shown at the Sixth Foundry Exhibition in Düsseldorf. A. Auchter (*Aluminium*, 1936, **18**, (12), 625–628).—Various new types of drilling and polishing tools for use on light metals are illustrated and briefly described.—A. R. P.

***Free-Cutting Light Metals and Their Machinability.** H. Opitz and W. Zimmermann (*Z.V.d.I.*, 1937, **81**, (37), 1085–1087).—Free-cutting aluminium alloys can be worked on automatic machines with cutting tools of the same type as is used for brass. The cutting properties of numerous alloys were tested, among them Duralumin with 1% bismuth.—v. G.

Turning and Machining of Light Metals. A. Wallichs (*Werkstatt u. Betrieb*, 1937, **70**, (19/20), 259–263; (21/22), 304–307).—The cutting properties of light alloys are contrasted with those of ferrous metals, and certain special precautions are indicated, together with suitable modifications in the form, setting, cutting-speed, feed, and lubrication of tools. The influence of the cutting-angle on the form of turnings is illustrated, and methods of minimizing wear on tools and of securing the optimum surface finish are discussed. Data regarding machinability with high-speed steel and hard-metal tools are tabulated, together with the principal properties of the alloy concerned, for 6 forging and 4 casting alloys. Wear on tools is shown to be influenced, in the latter instance, by the method of casting, and reference is made to the peculiar machining properties of certain individual alloys.—P. R.

Machining Light Alloys with Diamond Tools. —— (*Werkstatt u. Betrieb*, 1937, **70**, (19/20), 267–269).—The special advantages of diamond as a material for the working of light alloys are reviewed, and examples of its use in the boring of pistons and the manufacture of bearings are illustrated.—P. R.

Machine Tools for Light Alloys. H. H. Klein (*Werkstatt u. Betrieb*, 1937, **70**, (19/20), 263–265).—Light metals and alloys are classified according to their machining qualities, and suitable tools for various machining processes are described and illustrated; modifications in design arise from the tendency of ordinary tools to become clogged.—P. R.

Cutting Tools for Silumin. J. Dornauf (*Aluminium*, 1937, **19**, (3), 187–193).—A. R. P.

***Stability of Aluminium Against Drilling Oil Emulsions.** (Geller.)—See p. 628.

Files for the Working of Aluminium Alloys. A. v. Zeerleder, R. Irmann, and W. Müller (*Werkzeugmaschine*, 1936, **40**, (1), 7; and *Light Metals Research*, 1936, **5**, (9), 208–209).—L. A. O.

Machining of Copper Alloys. D. K. Crampton and H. P. Croft (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1130–1136).—A review, with 14 references. Tables give details regarding turning, cut-off, form, drilling, milling, and thread-cutting tools, band and circular saws, grinding abrasives, &c., and also the relative machinabilities of 21 copper alloys.—S. G.

†**Working of Bearings with Diamond Tools, Especially in the Cases of Leaded Bronzes, Phosphor–Bronzes, Aluminium, and Aluminium Alloys.** —— (*Metallwirtschaft*, 1937, **16**, (32), 802–804).—Practical hints are given; the tool should travel at the rate of 0·02–0·04 mm./revolution and the cutting speed should

not exceed 60–100 m./minute. The tools are particularly useful for cutting porous bearings; without their use the pores get pressed together.—v. G.

Machining Magnesium. H. Menking (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1220–1224).—Deals with tools, milling and turning, reaming, drilling, tapping, grinding, polishing, sawing, filing, lubricating and cooling, and fire precautions.—S. G.

How to Cut Stainless-Clad and Nickel-Clad Steel Plate. H. V. Inskeek (*Weld. J.* (*J. Amer. Weld. Soc.*), 1937, **16**, (8), 2–5).—S. G.

The Machinability of Metals. O. W. Boston (*Canad. Chem. and Met.*, 1937, **21**, (3), 87–88).—Summary of a paper read before the Ontario Chapter of the American Society for Metals.—L. A. O.

Machinability: Resistance to Abrasion and Machining Properties. G. Schlesinger (*Automobile Eng.*, 1936, **26**, (353), 501–503).—Summary of a paper read before the Institution of Production Engineers.—L. A. O.

Cutting Fluids. O. W. Boston (*Inst. Mech. Eng., General Discuss. on Lubricants, Advance Copy*, **1937**, (Group III), 14–20).—The properties desired in a cutting fluid, and the types of fluid used, are summarized, and an account is given of the performance of these fluids. The influence of 11 cutting fluids on the torque of a twist-drill in each of 9 metals, including leaded brass and cast aluminium alloy, is then described. It is deduced that the performances of a cutting fluid with two different metals are not necessarily the same. The influence of the fluids on the cutting force, cutting speed, finish, and temperature developed while turning metals is discussed.—R. Gr.

Cutting Fluids and Cooling Oils in Machine Tools. A. H. Lloyd and H. H. Beeny (*Inst. Mech. Eng., General Discuss. on Lubricants, Advance Copy*, **1937**, (Group III), 84–89).—Brass, cast phosphor–bronze, gun-metal, aluminium, and magnesium alloys are usually machined without any cooling or lubricating fluid; Monel metal and certain copper alloys require a cutting fluid. The choice of oil in relation to the cost of the tool is indicated, and the properties of various cutting oils outlined. Consideration is given throughout the paper to the relative merits of plain oils and water-soluble oil emulsions or " suds."—R. Gr.

The Application of Cutting Fluids. John F. Miller (*Inst. Mech. Eng., General Discuss. on Lubricants, Advance Copy*, **1937**, (Group III), 113–118).—Brief descriptions are given of the two types of cutting fluids—" water-soluble " oils and " straight " or neat oils and their functions are indicated. Breakdown of the soluble oil emulsion may occur when machining brass with high lead or zinc contents, owing to slight attack between fatty oil, lead, or zinc, to give oleates, which settle out as a curd and disturb the homogeneity of the emulsion. The remedy is frequent renewal, or the use of " straight " oil. Tarnishing of copper-rich alloys machined with a sulphurized " straight " oil may occur, owing to a sulphur–copper reaction. Wet- *versus* dry-cutting is considered, and it is recommended that no fluid should be used when cutting magnesium alloys; in almost all other cases fluid should be used to improve tool life and finish. Future developments in cutting fluids are indicated, and the use of metallic oleates in conjunction with sulphur for these fluids is predicted.—R. Gr.

The Laboratory for Machine Tools and Machinability at the Technische Hochschule, Aachen. H. Opitz (*Aluminium*, 1937, **19**, (3), 125–128).—An illustrated description of a modern laboratory and its equipment for determining the workability of metals and alloys by various cutting tools.—A. R. P.

Metal Cutting with the Electric Arc. Charles H. Jennings (*Machinist*, (*Eur. Edn.*), 1937, **81**, (40), 916–919).—When smooth, uniform cut surfaces are not required, arc-cutting is much cheaper than gas-cutting; it has the further advantage that it is equally applicable to ferrous and non-ferrous metals. Whilst the greater part of all arc-cutting is done with graphite or carbon electrodes, coated electrodes, although less economical, are useful on small jobs where an oxy-acetylene torch or a carbon electrode is not available. Electrodes with either gaseous- or slugging-type coatings can be used for arc-cutting, but the latter type generally gives the better results, because higher current densities can be used.—J. H. W.

XIX.—CLEANING AND FINISHING

(Continued from pp. 555–558.)

Metal Degreasing Before Electroplating. Multi-Liquor Trichlorethylene Plants. —— (*Met. Ind.* (*Lond.*), 1937, 51, (7), 167–168).—S. G.

Metal Cleaning—Principles and Practice. C. B. F. Young (*Met. Ind.* (*N.Y.*), 1937, **35**, (9), 446–450).—Some modern American cleaning machines are described and illustrated.—A. R. P.

Cleaning of Metallic Surfaces. C. B. F. Young (*Iron Age*, 1937, **140**, (16), 185–200; (17), 40–43).—Y. describes the various types of protective coatings (metallic, organic, and inorganic) which may be applied to metallic surfaces, and discusses in detail the various organic and inorganic materials which may contaminate the surfaces and cause poor amplification of a protective coating. The efficient and economical removal of these foreign materials is also fully described.—J. H. W.

Chemical Cleaning of Parts Made of Aluminium and Duralumin in the Aeroplane Building Industry. —— Maiborada and —— Korolev (*Avropromishlennost* (*Aero. Ind.*), **1936**, (8/9), 33–34).—[In Russian.] The parts are immersed in warm (50°–60° C.) 5% caustic soda solution containing 1% of sodium chloride for 30 seconds, thoroughly washed, immersed in concentrated nitric acid, and again washed in water. The method should be applied before welding.—N. A.

Precautions in the Cleaning of Aluminium Tanks with Nitric Acid. —— (*Illust. Zeit. Blechindustrie*, 1937, **66**, (33), 942–943).—The use of dilute nitric acid for the removal of deposits from the walls of aluminium brewing vats, whilst obviating attack on the metal, may result in the production of nitrous fumes due to oxidation of the oxalic acid in the deposits. Methods of protection, and of treatment in case of poisoning, are described.—P. R.

Cleaning for Hot-Dip Galvanizing and Tinning. Wallace G. Imhoff (*Iron Age*, 1937, **140**, (14), 37–41).—Describes the surface required and the cleaning equipment for successful galvanizing, the cleaning for hot-dip tinning, and the process of hot-dip tinning, which involves greater difficulties than hot-dip galvanizing.—J. H. W.

Centrifugal Sand-Blasting Apparatus Operated Without the Use of Compressed Air. —— (*Machines*, **1937**, (Aug./Sept.), 20–23).—Centrifugal sand-blasting machinery, which has proved less economical in operation than compressed-air plant when ordinary sand is used, can be usefully employed in shot-cleaning. Details are given regarding the design, size, power-consumption, and efficiency of centrifugal (paddle-wheel) machines.—P. R.

***Sand-Blasting and Silicosis.** W. Bergerhoff (*Arch. Gewerbpath. u. Gewerbehyg.*, 1936, **7**, 156–181; *J. Indust. Hyg.* (*Abs.*), 1937, **19**, 87).—Of 175 workers employed in sand-blasting, who were examined by B., 100 were fit for the work and 75 were unfit. In 24, definite pulmonary tuberculosis was diagnosed. Effective protection can be obtained by masks and special helmets that are supplied with fresh air.—S. G.

†From the Literature on Surface-Treatment [of Metals]. H. Krause (*Maschinenbau*, 1937, **16**, (17/18), 462–463).—Summarizes the most important recent German literature dealing with grinding, polishing, pickling, chemical cleaning, provision of protective coatings by chemical and electrochemical means and by immersion in molten salts, and pointing.—v. G.

New Finishes—New Results. Leo Roon (*Proc. Amer. Electroplaters' Soc.*, 1937, 155–158; discussion, 158–160).—The properties of plasticized chlorinated rubber as a protective finish to metal products are briefly described. The coatings adhere well to most metals, are resistant to acids, alkalis, mineral oils, alcohol, and outdoor weathering, have a good flexibility, and are easily applied.—A. R. P.

Metal Colouring. C. B. F. Young (*Amer. Soc. Metals Preprint*, **1937**, (Oct.), 13 pp.).—Aluminium can be given a dead white coating by boiling it in a suspension of lime 10 and gypsum 10 grm./litre; the coating can be dyed with organic or inorganic pigments. A black coating is obtained by immersion in a solution of potassium permanganate 10, copper nitrate 25 grm., and nitric acid 4 c.c./litre. Anodizing and colouring methods are also described. Cadmium is coloured black in a solution containing potassium chlorate 6 and copper chloride 7 grm./litre, and brown in a solution of copper nitrate 30 and potassium permanganate 2·5 grm./litre. Chromium plate is coloured black by immersion for 2 minutes in sodium cyanide at 760° C. Several formulæ are given for coating copper and brass black, brown, blue, or green, for depositing coloured gold plates, for colouring iron and steel, and for producing coloured nickel plates. An attractive ebony black finish may be obtained on magnesium by treating it anodically in a warm solution containing chromic acid 100–200, and trisodium phosphate 100–250 grm./litre; the bath is operated at 15–30 amp. at a p_H of about 3. Methods of colouring zinc and zinc-base die-castings by immersion in solutions containing various copper salts are also described.—A. R. P.

Metal-Finishing Economics.—IV. Herbert R. Simonds (*Iron Age*, 1937, **140**, (15), 32–35).—In a new finishing process for metal, called " Electrocolor," an alkaline solution of copper lactate produces cathodic depositions, at low current density, which are highly coloured. The colour of the deposition is a function of its thickness, and thus of the plating time. Violet, blue, green, yellow, orange, and red, with intermediate shades, appear successively with each cycle. The deposit, which appears to be primarily cuprous oxide, is chemically and mechanically stable, and can be applied to a large variety of metals. The application of this process in the shop, and its advantages, are described.—J. H. W.

Finishing Small Magnesium-Base Alloy Components. E. E. H[alls] (*Machinery* (*Lond.*), 1937, **51**, (1306), 77–79).—The results of hot-, cold-, wet-, and dry-cycle tests and salt-spray tests of the corrosion-resistance of various finishes on a magnesium alloy containing aluminium 8% are described. These illustrate the value of a preliminary treatment in an aqueous solution containing sodium or potassium dichromate, the value of a zinc chromate primer, and the advantages of a stoved finish. Cellulose finishes are unreliable.—J. C. C.

Improved Finishes for Die-Castings. Herbert Chase (*Machinist* (*Eur. Edn.*), 1937, **81**, 745–748).—In the Harshaw bright nickel-plating system for die-castings, plating is done with a normal Watts type of solution to which are added a brightener, a pit-preventing agent, and an organic carrier. Full details of the process are not yet available. As a rule, a copper flash 0·0003 in. minimum for a total copper–nickel coat of 0·008–0·001 in. minimum is preferred. The corrosion of zinc-alloy castings subjected to severe conditions may be minimized by dipping in a " Cronak " solution. The use of tough organic finishes and the acid dip and of high baking for aluminium alloys is described.—J. H. W.

Barrel Finishing. William J. Gray (*Proc. Amer. Electroplaters' Soc.*, **1937**, 143–148; discussion, 148–150).—Modern practice in finishing plated articles by sand-rolling, ball-burnishing, bright-rolling, and colour-finishing in barrels is briefly described.—A. R. P.

Tumbling [of Non-Ferrous Components] with Sawdust. P. Mabb (*Machinery* (*Lond.*), 1937, 51, (1305), 44–45).—Light polishing operations are frequently performed by barrel-tumbling in a soap solution, with the addition of sawdust, steel balls, and chamois leather to accelerate the process. Sawdust alone may be used for dry-polishing, and also as a final drying operation. Box-wood sawdust is generally used, as it is non-resinous and non-acidic, and it should be free from fine dust. Sieve analyses, with bulk density and moisture determinations, on some commercial sawdusts are tabulated.—J. C. C.

Surface-Treatment of Aluminium. Eugen Werner (*Oberflächentechnik*, 1937, 14, (16), 164–165).—Methods of obtaining artistic finishes on aluminium by mechanical and chemical means are briefly described.—A. R. P.

The Grinding and Polishing of Aluminium and Its Alloys. W. Hofmann (*Werkstatt u. Betrieb*, 1937, 70, (19/20), 266–267).—Carborundum is preferred to emery as a grinding material for light alloys. The latter demand some modification of the methods suited for grinding ferrous materials; appropriate adaptations are indicated, and an illustrated description is given of a machine for use on rod or on cylindrical pieces of relatively large diameter. —P. R.

***The Influence of Electrolyte Solutions on the Velocity of Polishing of Metals.—I.** A. G. Samarzev and V. P. Lavrov (*Zhurnal Tehnicheskoy Fiziki* (*J. Tech. Physics*), 1937, 7, (1), 24–29).—[In Russian.] A study was made of the influence of electrolytes on the speed of polishing of soft iron, nickel, stainless steel, silver, and copper on a glass disc, with graded emery powders. The results indicate that the use of different electrolytes as wetting media has a marked effect on the polishing speed, some electrolytes increasing it as much as eight to ten times as compared with others. The controlling factor appears to be the nature of the anion, although the presence of cations with a lower potential than that of the metal being polished also has a pronounced effect. The effect is probably due to the corrosive action of the electrolyte. —N. A.

The Care and Preparation of Polishing Wheels. Robert T. Kent (*Metal Cleaning and Finishing*, 1937, 9, (6), 527–532).—S. G.

XX.—JOINING

(Continued from pp. 558–561.)

Contact Pastes for Joints in Aluminium. H. Lux (*Aluminium*, 1937, 19, (3), 229–230).—For sealing screwed joints and similar pressure contacts in aluminium and light alloys, pastes consisting of various neutral greases containing sharp metal particles are recommended; these particles break the natural oxide film under pressures exceeding 0·5 kg./mm.^{2}, and thus ensure good metal-to-metal contact, while the grease prevents all risk of electrolytic corrosion.—A. R. P.

Bendable Unions for Aluminium Conductor Rails. R. Schulze (*Aluminium*, 1937, 19, (5), 337–338).—Since aluminium has a high coeff. of thermal expansion, it is necessary to allow sufficient room at the joints for heavy aluminium conductors to expand, and for this purpose bendable expansion pieces are arranged between each pair of conductors; the design, arrangement, and method of welding these pieces to the conductors are described with reference to illustrations.—A. R. P.

Heating and Short-Circuiting Tests on Aluminium Joints. H. Eberth and K. A. Lohausen (*Aluminium*, 1937, 19, (7), 478–480).—The results of tests made with various types of screw and clamped joints in aluminium and copper conductors are tabulated. For aluminium, steel screws are recommended as providing a better contact, and greater ease of tightening without danger to the thread.—A. R. P.

***A New Method of Joining Metal Parts to Ceramic Bodies.** W. Osenberg (*Maschinenbau*, 1937, **16**, (19/20), 495–498).—Metal plugs are inserted into holes drilled in the ceramic body, heated by passage of a current, and gently pressed, by means of the electrodes, until they are held fast. Various applications of the process are described.—v. G.

Riveting of Magnesium. H. Menking (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1229–1230).—Deals briefly with the rivet alloy, physical properties of 5% magnesium alloy rivets, the design and preparation of riveted joints, and corrosion prevention.—S. G.

Hollow Rivets. E. Herrmann (*Aluminium*, 1937, **19**, (8), 523–531).—A review of the journal and patent literature of the past 20 years.—A. R. P.

The Soldering of Aluminium. M. Bosshard (*Werkstatt u. Betrieb*, 1937, **70**, (21/22), 293–294).—The hard-soldering of aluminium—the similarity of which to autogenous welding is emphasized—demands careful selection of both flux and solder: recommendations are made in both respects. For soft soldering, either pure zinc or a zinc–tin–copper–lead alloy of stated composition are recommended; oxides may be removed either mechanically or by the use of a suitable flux. Instructions are given for cleaning by both methods.—P. R.

Hard-Soldering in the Salt Bath. E. Schau (*Durferrit-Hausmitt.*, 1937, **6**, (13), 137–144).—The loss of soldering alloy (brass) in the old-fashioned dipping process is shown to be considerable. In the process described, a small amount of the alloy is held in a socket in the clip connecting the parts to be joined; the joint is dipped in the salt bath, and withdrawn after a suitable interval. The process is applicable to bicycle and automobile construction. Working details are indicated, and the type of finish obtained is illustrated.—P. R.

***Solders With and Without a Small Amount of Tin.** A. I. Shpagin (*Zvetnye Metally* (*Non-Ferrous Metals*), **1937**, (3), 89–104).—[In Russian.] As substitutes for ordinary lead–tin solders, the following alloys are recommended: (1) PO-15, lead 85, tin 15%, melting point 285° C.; (2) PS-6, lead 90, tin 4, antimony 6%, melting point 245° C.; (3) PKO-5, lead 85, tin 10, cadmium 5%, melting point 260° C.; (4) PKO-6, lead 88, tin 10, cadmium 2%, melting point 275° C. Conditions suitable for the use of these solders are described. —N. A.

Soldering Tubes with Flux. V. A. Pereslegin and A. I. Shpagin (*Zvetnye Metally* (*Non-Ferrous Metals*), **1937**, (1), 94–96).—[In Russian.] Methods of manufacture are described.—N. A.

Spray-Gun for Solder. —— (*Met. Ind.* (*Lond.*), 1937, **50**, (19), 538).—A brief description of a spray-pistol for applying solder to dented parts in automobile repair work. A special form of cold-tinning compound is used to secure adhesion.—H. W. G. H.

Welding Aluminium and Its Alloys. An Extended Abstract of Recent German Literature. —— (*Weld. J.* (*J. Amer. Weld. Soc.*), 1937, **16**, (7), suppt., 39–40).—An exceedingly brief review of 14 recent papers dealing with gas-, arc-, and resistance-welding.—H. W. G. H.

†Position of the Spot- and Seam-Welding of Light Metals. E. Rietsch (*Maschinenbau*, 1937, **16**, (17/18), 453–456).—In the resistance-welding of light metals, not only the voltage and current strength, but also the time during which the current is passed, must be rigorously controlled (cf. Fröhmer, *Met. Abs.*, 1936, **3**, 325). In this way aluminium alloy sheets can be welded so that the strength of the joint is superior to that of a riveted joint; such joints give almost equal results to riveted joints in the alternating tensile test. Welds in Duralumin sheet can be hardened by suitable heat-treatment. —v. G.

Aluminium Welding. Chemical and Metallurgical Aspects. J. P. J. Buckley (*Modern Eng.*, 1937, 11, (7), 390–392).—The properties of aluminium and alumina are described, and details are given of the technique to be adopted for welding a crankcase.—H. W. G. H.

Aluminium Welds. Strength of Welds on Thick Plates. H. Buchholz (*Aluminium and Non-Ferrous Rev.*, 1937, 2, (12), 429–431; 3, (1), 41–42; (2)).—Translated from *Z.V.d.I.*, 1937, 18, 433–437; see *Met. Abs.*, this vol., p. 307.—S. G.

***Investigation of Welding Fluxes for Aluminium and Its Alloys.** A. S. Berman (*Avtogennoe Delo* (*Autogenous Practice*), **1936**, (12), 15–17).—Four alkali salts mixtures have been tested for their value as oxide solvents and effect on the surface of the weld metal, and from the point of view of ease of application and removal. The best results were obtained with a mixture of potassium chloride 45, sodium chloride 30, lithium chloride 15, lithium fluoride 3·5, sodium fluoride 3·5, and potassium pyrosulphate 3%.—N. A.

Flux for Welding Aluminium Alloys. A. Berman (*Aviopromishlennost* (*Air Ind.*), **1936**, (7), 22–23).—[In Russian.] The composition of the flux is KCl 45, NaCl 30, LiF 3·5, NaF 3·5, LiCl 15, $KHSO_4$ 3%; its preparation and the results obtained by its use are described.—N. A.

The Arcatom Process and Its Use in Welding Aluminium and Aluminium Alloys. E. Thiemer (*Metallwirtschaft*, 1937, **16**, (33), 814–816).—All aluminium and magnesium alloys can be welded by the Arcatom process, using the usual fluxes. The mechanical properties and resistance to corrosion of the resulting welds are good.—v. G.

The Gas-Welding of Light Metals. A. v. Zeerleder (*Werkstatt u. Betrieb*, 1937, **70**, (21–22), 287–289).—Practical directions for acetylene-welding of light alloys include recommendations regarding choice of flux, position of flame, size of welding rod, and methods of preheating. A diagram of hardness variation near the weld in Anticorodal sheet illustrates the results of carefully-controlled heat-treatment of the welded material.—P. R.

Autogenous Welding of Magnesium–Aluminium Alloys (Alumag). J. Herenguel (*Acad. Méditerranéenne: Symposium "La Corrosion par l'Eau de Mer,"* **1937**, 259–266).—[In French.] Methods of gas-welding and resistance-welding aluminium alloys with 6–8% magnesium are described, with reference to diagrams. To ensure absence of corrosion, it is essential to remove all flux after soldering; this can frequently be done by means of a wire-brush, or the metal may be treated first with 10% caustic soda, then with nitric acid, thoroughly washed in running water, and dried. Good joints from which all flux has been removed should withstand the salt-spray test for 3000 hrs. without deterioration.—A. R. P.

Experiments on Welding Stamped Tanks Made of an Aluminium–Manganese Alloy. I. I. Kachanov (*Aviopromishlennost* (*Air Ind.*), **1937**, (5), 46–48).—[In Russian.] Methods of manufacturing petrol tanks from the manganese–aluminium alloy B 95 are described, together with methods for examining the seams metallographically, and for testing the tanks for resistance to vibration.—N. A.

The Stelliting of Valves for Marine Diesel Engines. —— (*Soudeur-Coupeur*, 1937, **16**, (7), 4–9).—Stellite is applied to large Diesel engine valves to protect them from high-temperature oxidation. Differential expansion of the Stellite and the steel of the valve is liable to cause cracking unless the composition of the latter is carefully chosen.—H. W. G. H.

Welding of Copper. A. P. Young (*Weld. J.* (*J. Amer. Weld. Soc.*), 1937, **16**, (10), suppt., 30–40).—Copper plates, varying in thickness from $\frac{1}{8}$ to $\frac{1}{2}$ in., were welded by oxy-acetylene and carbon arc, using phosphor–bronze filler rods containing varying amounts of tin. The welded plates were cut into coupons for tensile testing, and the results are tabulated, together with details of welding technique. For both types of weld, the plates were clamped—on a cast-iron table for the gas-welding, and against a grooved copper backing-bar for the arc-welding. Bend and hardness tests, and microscopical examinations, were also carried out. The efficiencies of the gas-welds were found to be lower than those of the arc-welds, apparently because of the greater length of time the plate is exposed to high temperatures in the former process.—H. W. G. H.

Welded Copper Joints That Can Be Tested On Completion. —— (*Elect. Welding*, 1937, 7, (37), 22–23).—A brief note. Socket joints in pipes are made so that there is an annular space between the two fillet welds inside and outside the overlap. The welds are tested by applying hydraulic pressure to this space.—H. W. G. H.

***Spot-Welding Characteristics of Some Copper-Base Alloys.** D. K. Crampton and J. J. Vreeland (*Weld. J.* (*J. Amer. Weld. Soc.*), **1937**, **16**, (10), suppt., 9–18; and *Met. Ind.* (*Lond.*), 1937, **51**, (21), 505–509; (22), 527–530.—Two interesting methods of testing spot-welds are described. In the first, two small strip specimens are welded, at right-angles, by a single spot, accurately centred so that, when the welded specimen is placed in the testing device, one strip is held in a stationary groove and the other fits in a groove in a rotating disc, the centre of which is co-axial with the centre of the weld. By means of a cord at the periphery of the rotating disc, and a spring balance, the maximum torque sustained by the weld is measured. For the second test, two circular blanks are welded together by a series of spots concentrically spaced, and the whole is clamped in a jig to keep the edges pressure-tight. Water is then pumped into the space between the spot-welds by means of a tube welded into the centre of one disc, and the bursting pressure is noted. The paper deals with the application of these tests to welds made in five copper–zinc alloys of varying composition, manganese–brass, aluminium–brass, silicon–brass, silicon–bronze, phosphor–bronze, a work-hardening nickel–aluminium bronze, and a precipitation-hardening nickel–aluminium bronze. All the welds were made on material 0·036 in. thick with a 150 kva. spot-welding machine fitted with balanced air-operated head and electron tube timing control. Electrode tips of copper–chromium alloy were used. A series of test welds was made on each of the materials, the number of cycles, electrode pressure, and electrical input being varied, and the welds submitted to the torsion test. The results are all tabulated. From these, the set of conditions which appeared most suitable for each alloy was then used to prepare specimens for pressure testing, the results of which are also given. Measurements of contact-resistance showed no direct relation to the electrical conductivity of the alloys, but decreased rapidly with increase of electrode pressure. The silicon bronze appeared to have the best welding characteristics.—H. W. G. H.

The Welding of Aluminium Bronze by the Electric Arc. G. Becker and H. Groebler (*Elektroschweissung*, 1937, 8, (7), 132–134).—The formation of a tenacious oxide film, and the high thermal conductivity, make welding of aluminium bronzes difficult. A coating for electrodes was developed on the lines of the coatings used for aluminium electrodes. The technique recommended is similar to that used for aluminium, but the arc is kept longer, and the molten metal passes from the electrode in larger drops. Welding is carried out with d.c., the electrode being connected to the positive pole. A 4-mm. electrode requires about 200 amp.—H. W. G. H.

***Welding of Bronze Without Preheating.** A. L. Shermushenko (*Vodnii Transport* (*Water Transport*), **1937**, (2), 12).—[In Russian.] Dense, non-porous joints can be made in bronze by electric welding with a welding rod consisting of an alloy of copper with tin 3·97, zinc 10·96, lead 0·37, and iron 0·53%, coated with a mixture of carborundum 60, aluminium 25, barium carbonate 10, and rutile 5%.

***Gas-Welding of Brass.** I. J. Surovzev (*Aviopromishlennost* (*Air Ind.*), **1937**, (4), 35–40).—[In Russian.] The main defects in the gas-welding of brass (gas-filled pores, and cavities in the seam) cannot be remedied by changing the character of the flame, by using a borax flux, or by subsequent hammering. Satisfactory seams may be obtained, however, by using boric acid as flux, and a flame containing an excess of acetylene.—N. A.

Autogenous Welding of Brass. P. Hollard (*Cuivre et Laiton*, 1937, **10**, (199), 225–227).—In general, a normal (*i.e.* neither oxidizing nor reducing) flame should be employed, but it is found that with a slight, critical percentage of oxygen the bath of metal on the join is more tranquil and there is less volatilization. This critical composition of the flame gases is dependent on the compositions of the alloy and of the welding rod, which are the same.
—W. A. C. N.

Repair of Red Brass Parts by Electric Welding. —— Kohrs and —— Radon (*Weld. Ind.*, 1937, **5**, (7), 235–237).—Parts of red brass (copper 85, tin 5, zinc 10%) are built up by the metallic process, using electrodes of the same composition on the positive pole. A 5-mm. electrode takes 250–300 amp. The building-up is facilitated by the use of carbon moulds.
—H. W. G. H.

Roll-Welding of Brass. L. F. Golovin (*Zvetnye Metally* (*Non-Ferrous Metals*), **1936**, (10), 100–104).—[In Russian.] To obtain a good welded seam in brass without overheating, it is necessary to observe strictly the prescribed procedure. A good interrupter is indispensable. The pieces must be annealed after welding to remove welding stresses; the annealing temperature depends on the composition of the alloy, 650° C. being the best for 60 : 40 brass. Correctly welded seams can be deep-drawn.—N. A.

Welding Magnesium Alloys. H. Menking (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1225–1228).—A review.—S. G.

The Autogenous Welding of Elektron and Hydronalium. Fredo Graal (*Werkstatt u. Betrieb*, 1937, **70**, (21/22), 289–292).—Elektron is usually acetylene-welded, as the plant can be used on other materials. The trade designations of several types of semi-finished cast, forged, and pressed Elektron pieces, and of the appropriate welding wire, are tabulated, with their chemical compositions and tensile properties; minor differences in treatment are indicated, and directions are given regarding flame, flux, welding of sheet, and pre-heating and welding of castings. Data regarding composition and tensile properties are tabulated for 6 commercial grades of Hydronalium sheet, and the ultimate tensile strength and elongation of welded joints are given for 7 Hydronalium alloys in different conditions of preparation and/or working.
—P. R.

Spot-Welding of Elektron. I. Kachanov and A. Daidurov (*Aviopromishlennost* (*Air Ind.*), **1937**, (1), 27–33).—[In Russian.] Elektron is easily spot-welded mechanically. The ATN 25 machine will weld satisfactorily Elektron sheets up to 10 mm. thick. To avoid wrinkling and splashing a high pressure is required, and the welding time should not exceed 0·35 second, which is attained by means of an interrupter. The mechanical properties of the joints are superior to those of riveted joints, and their corrosion-resistance is greater than that of the original material. Electrodes with a spherical contact surface are preferable.—N. A.

Electric Spot-Welding of Elektron. I. M. Braylovsky (*Aviopromishlennost* (*Air Ind.*), **1937**, (3), 39–42).—[In Russian.] Elektron sheets can be spot-welded satisfactorily on automatic machines of the ATN 25 type. The strength of the joints is high (316 kg. per spot-weld for sheets 1·2 mm. thick). Spot-welds in a construction have a strength only about 8% less than that of a single weld, if the correct welding conditions have been chosen. Welds made with electrodes with polished tips are as resistant to corrosion as is the sheet itself.—N. A.

Electric Arc-Welding of Monel Metal Structures. James F. Maguire (*Weld. J.* (*J. Amer. Weld. Soc.*), 1937, **16**, (7), suppt., 4–7; and *Met. Ind.* (*Lond.*), 1937, **51**, (8), 177–179).—Covered electrodes, containing 2–2·75% aluminium and 0·42% titanium, are used for welding Monel metal at Watertown Arsenal (U.S.A.). Severely cold-worked plate requires stress-relieving at 575° C. for 5 hrs. before welding. Down-hand welding only is carried out, and all welded structures are stress-relieved. The welds are sand-blasted, and visually inspected. X-ray testing is extensively used.—H. W. G. H.

Zinc-Welding and Hard-Soldering of Galvanized Sheet in Practice. —— Nied (*Illust. Zeit. Blechindustrie*, 1937, **66**, (35), 1002–1003).—Recent restrictions on the use of tin in Germany have limited the tin content of solders to 15%. Zinc, which can be welded at 420° C., is preferable to inferior solders, and directions are given regarding the selection of burner and flux. A hard-soldering process, which is said to be more easily carried out than zinc-welding, is described.—P. R.

Building Up Locomotive Driving-Boxes. Irving T. Bennett (*Weld. J.* (*J. Amer. Weld. Soc.*), 1937, **16**, (10), 37–43).—Cast liners, depending on dovetails, &c., for securing, were not satisfactory and three possibilities were tested: (1) to build up the liner by arc-welding; (2) to weld a piece of rolled metal to the face of the box; and (3) to weld suitably designed segments of rolled material to the face of the box. Herculoy (copper 96, silicon 3·5, tin 0·5%) was selected as the material, and welding was carried out by the metallic arc process. All three methods gave good results, but the complete building-up process was the most flexible, and was finally adopted for production. Further developments in technique made it possible to deposit alloys with up to 15% lead, the dispersion of which by the arc process being more uniform than in normal cast material. Arc-deposited bearing bronzes were found to have tensile strengths and Izod values 50% greater than the cast materials. Some details are given of the technique used.—H. W. G. H.

Welded Brewery Plant. E. W. Eldin (*Welder*, 1937, **9**, (46), 268–270).—Refers briefly to copper, aluminium, stainless steel, Monel metal, &c.—H. H.

Cutting and Welding in the Coke-Oven Industry. —— (*Gas World: Coking Section Suppt.*, 1937, **107**, 106–108).—An account of the uses of oxy-acetylene in the repair and maintenance of plant at the coke ovens of the Consett Iron Co. includes a brief description of lead-burning and copper-welding.—A. R. Pe.

The Weldability of Ferrous and Non-Ferrous Metals. R. Smallman-Tew (*Elect. Welding*, 1937, **6**, (34), 113–116).—Metals are divided into three classes: those which can be strength-welded and reinforced by metallic arc-welding; those which require a special technique; and those of which welding by the metallic arc process is very difficult. Non-ferrous materials are placed in the last class.—H. W. G. H.

Welding of Non-Ferrous Metals. Discussion of Mr. Hignett's Paper. —— (*Weld. Ind.*, 1937, **5**, (1), 39–43).—See also *Met. Abs.*, this vol., p. 266. —S. G.

The Importance of Heat-Treatment in Welding Processes. C. W. Brett (*Wild-Barfield Heat-Treat. J.*, 1936, **2**, (11), 32–34).—Repairs to complex castings are most economically effected by welding, which in many cases must be preceded by heat-treatment. The assembly by welding of separately cast engine parts also necessitates heat-treatment in order to avoid distortion. Accurate temperature control is especially necessary in the case of light-alloy parts. Examples from industrial practice are briefly described.—P. R.

Welding—A Mutual Crystallization Process. A. A. Alov (*Avtogennoe Delo* (*Autogenous Practice*), **1936**, (12), 21–22).—[In Russian.] A discussion of the nature of the welding process.—N. A.

Failures and the Testing of Welds. (Wiegand.)—See p. 657.

Temperature Distribution During Welding. A Review of the Literature to January 1, 1937. W. Spraragen and G. E. Claussen (*Weld. J.* (*J. Amer.

Weld. Soc.), 1937, **16**, (9), suppt., 4–10).—40 references are given, but the review deals principally with one paper, by Portevin and Séférian (*Chaleur et Ind.*, 1935, **16**, 409–424) which, alone, mentions non-ferrous metals.—H. H.

Shrinkage Distortion in Welding. A Review of the Literature to January 1, 1937. W. Spraragen and G. E. Claussen (*Weld. J.* (*J. Amer. Weld. Soc.*), 1937, **16**, (7), suppt., 29–39).—A review, with a *bibliography* of 83 references. —H. W. G. H.

X-Ray Methods of Studying Stress-Relief in Welds. (Norton.)—See p. 661.

The Determination of the Residual Strains and Stresses in Arc-Welded Plates. H. E. Lance Martin (*Welder*, 1937, **9**, (42), 139–142, 146; (43), 174–187; (44), 215–216).—Read before the North-East Coast Institution of Engineers and Shipbuilders. See *Met. Abs.*, this vol., p. 561.—H. W. G. H.

Some Factors to be Considered in the Choice of a Welding Process. Louis J. Larson (*Weld. J.* (*J. Amer. Weld. Soc.*), 1937, **16**, (9), 40–45).—Describes hammer-welding, electric resistance, gas, atomic-hydrogen, metallic, and carbon-arc processes, giving examples of applications, and pointing out that choice of method depends on the cost of the plant, labour, material, power, and maintenance charges.—H. W. G. H.

On Atomic Hydrogen Welding. Katsuro Hayashi (*Denki no Tomo* (*Friends of Electricity*), 1937, **76**, (827), 276–281).—[In Japanese.] Reports favourably on the welding of stainless and other alloy steels, Nichrome, Monel metal, &c., by the atomic hydrogen method.—S. G.

Time Control Solves Spot-Welding Problems. H. Thomasson (*Weld. J.* (*J. Amer. Weld. Soc.*), 1937, **16**, (7), 26).—Using a chromium–copper as tip material, in a 100 kva. spot-welder fitted with ignitron control, 11 materials in 19 gauges were successful welded, and also 12 combinations of dissimilar metals. The operating conditions are tabulated.—H. W. G. H.

A New Control for Electrical Spot-Welding Machines. H. Wilbert (*Elektroschweissung*, 1937, **8**, (10), 190–191).—The welding current is controlled by mercury valves through a photo-electric cell circuit, and an electrical control governs the compressed air supply to the cylinder operating the upper electrode of the spot-welder. The two controlling systems are interconnected in such a way that a high initial electrode pressure precedes the formation of the weld, this pressure being reduced to increase the interfacial resistivity during the passing of the welding current, and being increased, when the current is switched off, in order to consolidate the weld. This " programme-welding " is particularly suitable for aluminium alloys.—H. W. G. H.

Modern Resistance-Welding in Germany. R. Bodlander (*Modern Eng.*, 1937, **11**, (6), 328–333).—Control by mercury rectifier valves, welding with heavy currents for stainless steel and aluminium, and mechanical improvements in machines are discussed.—H. W. G. H.

Developments in Resistance-Welding. L. B. Wilson (*Weld. Ind.*, 1937, **5**, (8), 297–301; discussion, 301–304).—Welding time and current and electrode pressure should be controlled and recorded for efficient spot-welding. Short times are obtained by the use of thyratron control gear. In projection-welding, large flat electrodes are used, and dimples are formed in the parts to be welded. The current passes through the dimples, which collapse under the pressure of the electrodes, producing very reliable welds. For this process it is essential that the material be clean. For non-ferrous metals, spot-welding tips should be efficiently cooled, and shaped to a wide-angle cone. In seam-welding, the length of time the current is flowing and the length of time between successive welds are controlled by thyratrons.—H. W. G. H.

Suggestions for Improving Quality of Resistance-Welds. A. M. MacFarland (*Weld. Eng.*, 1937, **22**, (8), 17–18).—Percussion-welding can give tough, ductile joints between dissimilar metals (*e.g.* chrome steel and phosphor-bronze) provided that the time factor is carefully controlled. The arc must be kept short enough to exclude the air from the weld. The use of protective atmospheres, to prevent oxidation, is predicted.—H. W. G. H.

Automatic Resistance-Welding. Harry Landstrom (*Weld. J.* (*J. Amer. Weld. Soc.*), 1937, **16**, (10), 12–14).—The necessity for automatic control of the various factors in resistance-welding is considered essential for producing consistent welds. Various types of modern controlling mechanisms are discussed.—H. W. G. H.

The Resistance-Welding Circuit. C. L. Pfeiffer (*Elect. Eng.*, 1936, **55**, (8), 868–873).—Deals with some of the problems encountered in the practical application of the resistance-welding circuit, with particular reference to the electrical constants and variables involved.—S. V. W.

New Developments in Ignitron-Welding Control. J. W. Dawson (*Elect. Eng.*, 1936, **55**, (12), 1371–1377).—The use of resistance-welding timers using igniter-type mercury–cathode tubes is reviewed briefly, and a seam-welding control unit, containing a new design of inductive timer, is described. An " ignition delay " form of control of welding heat or current magnitude is presented, in which one set of power tubes controls both current magnitude and time duration. This is compared with the tap-changing method, and the operation of several welding machines from one timer is discussed.—S. V. W.

Sealed-Off Ignitrons for Welding Control. David Packard and J. H. Hutchings (*Elect. Eng.*, 1937, **56**, (1), 37–40, 66; and *Gen. Elect. Rev.*, 1937, **40**, (2), 93–97).—Accurate control of high currents for resistance-welding may be obtained by igniter-type mercury–cathode tubes capable of conducting 7000 amp. in impulses of from less than 0·01 second to several seconds duration. The paper describes design principles and manufacturing technique for tubes of this type.—S. V. W.

Resistance-Welding Improved by Thyratron Control. Warren C. Hutchins (*Gen. Elect. Rev.*, 1937, **40**, (3), 116–124; and *Weld. J.* (*J. Amer. Weld. Soc.*), 1937, **16**, (8), 11–18).—By means of thyratron control, it is possible to control the passage of current in resistance-welding to a ½ cycle. Thus, having determined the correct period for any combination of metals to be welded, perfect welds can be repeated with certainty. This results in a general speeding-up of the process, and it has also made it possible to resistance-weld certain metals and alloys which previously were difficult to weld.—S. V. W.

Thyratron Control Equipment for Resistance-Welding. I.—Spot- and Seam-Welders. Harry L. Palmer (*Gen. Elect. Rev.*, 1937, **40**, (5), 229–235).—S. V. W.

Improved Control Methods for Resistance-Welding. J. G. Hall (*Weld. Ind.*, 1937, **5**, (9), 313–314).—The Ignitron combines the rapid response of the mercury-vapour hot-cathode rectifier with the heavy current-carrying capacity of the mercury arc rectifier, and thus provides flexibility, short timing, and accuracy of control for resistance-welding, together with long life and low maintenance costs.—H. W. G. H.

Carbon-Arc Welding in Marine Construction. Frank Hirner (*Weld. J.* (*J. Amer. Weld. Soc.*), 1937, **16**, (7), 27).—Coast-guard patrol boats were fitted with 2000 gall. oil tanks of 14-g. silicon–bronze, and water tanks of 16-g. Monel metal. These tanks were welded by carbon arc.—H. W. G. H.

Arc-Welding Power Supply. Roy L. Spaulding (*Weld. J.* (*J. Amer. Weld. Soc.*), 1937, **16**, (8), 8–10).—The requirements for a steady welding arc are explained, and some designs of d.c. and a.c. generators, to satisfy these requirements, are described. The most promising of future developments is thought to be the high-frequency generator.—H. W. G. H.

Welding and Voltage Control Using Kathetrons. Palmer H. Craig (*Electronics*, 1937, **10**, (9), 26–28).—The electrical implications in the use of Kathetrons for the control of welding and voltage are given. Several suitable electrical circuit diagrams are included.—E. V. W.

The Diagrams of Welding Generators. Karl Humburg (*Elektroschweissung*, 1937, 8, (6), 107–110).—The dynamic characteristic of a welding generator is explained, distinction being made between the no-load voltage as shown by the static characteristic and the reserve voltage available at short circuit. The important factor in the behaviour of a generator is shown to be the fictitious resistance, or the ratio of the open-circuit voltage to the current surge on short circuit.—H. W. G. H.

Developments in the Field of Acetylene Generator Construction. Helmut Koch (*Autogene Metallbearbeitung*, 1937, 30, (15), 257–261).—Describes the latest German high-pressure, fully automatic, and " sludge-less " generators. —H. W. G. H.

Sources of Danger in the Use of Generated and Bottled Acetylene and Their Elimination. H. Friedrich (*Autogene Metallbearbeitung*, 1937, 30, (11), 163–170; (12), 181–187).—Presents an outline of researches carried out at the Reichsanstalt, and the results obtained.—H. W. G. H.

Health Protection for Welders. —— (*Metropolitan Life Insurance Co.* (New York): 1937).—An illustrated pamphlet describing safe practices in welding, and the general precautionary measures recommended.—S. G.

XXI.—INDUSTRIAL USES AND APPLICATIONS

(Continued from pp. 561–567.)

Progress in Light Alloys. A. J. Dornblatt (*Metal Progress*, 1937, 32, (4), 575–581).—A review, containing brief references to improvements in: the extraction of aluminium; aluminium and magnesium alloys for structural and other purposes; casting, forging, and rolling methods; and to numerous minor applications of aluminium and magnesium. Developments in die-casting and associated processes are emphasized.—P. R.

The Standardization of Aluminium and Its Alloys. H. Hornauer (*Werkstatt u. Betrieb*, 1937, 70, (19/20), 254–255).—The numbers of the German standard specifications (DIN) for aluminium and light alloys are quoted, and the official nomenclature is explained.—P. R.

Applications of Aluminium and Light Alloys. H. Schallbroch and O. Löscher (*Werkstatt u. Betrieb*, 1937, 70, (19/20), 275–276; (21/22), 297–301). —The properties of pure aluminium and of the main groups of aluminium and magnesium alloys are reviewed, with special reference to their suitability as substitutes for materials the use of which in new construction is now prohibited in Germany. The special possibilities of light alloys which have been plated or protected by oxide coatings are emphasized.—P. R.

***Tests of Thin Hemispherical Shells Subjected to Internal Hydrostatic Pressure.** Wilbur M. Wilson and Joseph Marin (*Univ. Illinois Bull.*, 1937, 34, (75), 5–20).—Experiments on thin hemispherical shells of steel and the aluminium alloy 51 S indicate that, if thin spherical shell structures of a ductile metal subjected to internal pressure are so designed that the allowable unit stress in the shell is equal to the allowable unit stress in the material when subjected to simple tension, the design will be safe. The actual value of the strength of the aluminium alloy shells was about 16% below that computed from the shear, stress, or shear–energy theories, 28% below that computed from the strain–energy theory, and 24% above that computed from the strain theory.—A. R. P.

Bread-Baking Dishes of Aluminium. —— (*Aluminium*, 1937, 19, (7), 480–481).—Aluminium dishes have been used very successfully for baking bread in America; although they are 3 times as expensive as the ordinary tins, they have an effective life of 3–4 years, and, owing to their better heat conductivity, the bread bakes more quickly in them than in tins, thus saving time and fuel cost.—A. R. P.

Aluminium in the Milk Industry. P. Schwerber (*Aluminium*, 1937, **19**, (8), 493–501).—Examples are given of the use of aluminium for milk cans, pasteurizers, storage and transport tanks, &c.—A. R. P.

***Feeding Experiments with Canned Food Packed in Aluminium Containers.** Gulbrand Lunde, Valborg Aschehoug, and Hans Kringstad (*J. Soc. Chem. Ind.*, 1937, **56**, (9), 334–339T).—Fish (sardines, herrings, and crab) preserved in aluminium cans takes up small quantities of aluminium, which may amount to about 100 mg./kg. of food after several years. Experiments on mice and rats showed that this amount of dissolved aluminium had no effect whatever on the growth or metabolism of the animals, and that there was no accumulation of aluminium in the body.—A. R. P.

***Research in Light Metal Damage to Experimental Animals.** G. Gerlach (*Bruns. Beitr. klin. Chir.*, 1936, **164**, 430–436; *J. Indust. Hyg.* (*Abs.*), 1937, **19**, 38).—Remarkable damage to animals is seen in G.'s experiments in which needles, pointed at both ends, were sunk into the liver and muscles. It was shown that metals with a high percentage of magnesium, especially Elektron and its variations, have a damaging action as if from microscopic cutting. G.'s explanation is that the magnesium takes up oxygen and forms magnesium oxide. The hydrogen thus freed causes widespread gas-bubble formation in the tissue, and the tissue thus broken down serves as favourable medium for infection.—S. G.

Injury from Light Metal, and Its Significance in Industrial Hygiene. W. Ehrlich (*Arch. Gewerbepath. u. Gewerbehyg.*, 1937, **7**, 517–531; *J. Indust. Hyg.* (*Abs.*), 1937, **19**, 110).—On the basis of 2 years' experience and observation of 913 cases of injuries from light metal, E. points out how frequently such injuries lead to prolonged, inflamed swelling. Especially frequent are inflamed skin diseases, eczema, &c. One cause lies in the fact that on the surface of these metals—unlike heavy metals—multitudes of cocci adhere (including staphylococci), that the surface of the tiny splinters is fissured and has tiny barbs.—S. G.

Damage from Light Metal. H. Gissel (*Z. Gewerbehyg. u. Unfall.*, 1936, **43**, 133–135; *J. Indust. Hyg.* (*Abs.*), 1937, **19**, 8).—Workers with light metals, especially Duralumin, showed extensive inflammation and suppuration after slight injuries, as well as inflammation of the skin. The cause of the latter is not yet determined. The work of Gerlach and of Ehrlich (preceding abstracts) is referred to.—S. G.

Injuries from Light Metals. — Kōtzing (*Arbeitsschutz*, **1937**, 77–78; *J. Indust. Hyg.* (*Abs.*), 1937, **19**, 131).—K., who writes on the basis of reviewing over 16,700 cases of light metal injury, adds nothing to what has been frequently described in the literature. He recommends purification of the flesh around the wound with benzine and binding with " bacteria killing " salve or sterile material.—S. G.

Light Metals in the Tableware Industry. Helmuth Fischbach (*Aluminium*, 1937, **19**, (8), 558–560).—Recent improvements in the manufacture of aluminium spoons and forks are described.—A. R. P.

Modern Applications of Light Metals in the Gas Industry. P. Schwerber (*Aluminium*, 1937, **19**, (8), 556–557).—Aluminium alloys are now extensively used in German gasworks for handling ammonia liquors, producer gas, and various oils, as well as for making benzene stills, smoke hoods, coke-handling plant, &c.—A. R. P.

The Crankless Compressor for Gas Handling. C. H. S. Tupholme (*Amer. Gas J.*, 1937, **147**, 11–12).—The pistons are made of aluminium, and the cups into which the slipper pads fit are of phosphor-bronze.—A. R. Pe.

The Development, Design, and Use of Light Metal Bearings. H. Wiechell (*Light Metals Research*, 1937, **5**, (21), 479A–481).—Summarized from *Automobiltech. Zeit.*, 1937, **40**, (9), 235–240; see *Met. Abs.*, this vol., p. 309.—L. O.

Free Transmission Lines and Their Connection to Private Houses. —— (*Aluminium*, 1937, 19, (1), 23–30).—Methods of making connections between aluminium overhead electric light and power wires, supplying current to private houses, and the internal distribution system, are described and illustrated. Types of insulators, safety devices, &c., are also shown.—A. R. P.

Erection of Vibration-Damped Overhead [Aluminium] Cables on a 100 kv. Service. P. Behrens (*Aluminium*, 1937, 19, (9), 573–576).—Methods used in erecting the cable and making the joints are described with reference to diagrams.—A. R. P.

Aluminium Overhead Transmission Lines in Scandinavia. J. A. Somdal (*Aluminium*, 1937, 19, (9), 577–584).—Details are given of the use of steel-cored aluminium cables for the electrical grid systems in Norway, Sweden, and Denmark.—A. R. P.

On the Electrical Conductivity of Aluminium for Free Conductors. A. Schulze (*Aluminium*, 1237, 19, (9), 584–585).—Aluminium wires used for making overhead cables in Germany have a mean specific resistance at 20° C. of $0 \cdot 02810\ \Omega/\text{mm.}^2/\text{m.}$, with a tensile strength of $19\ \text{kg./mm.}^2$, and d 2·705. —A. R. P.

I.S.A. Tolerances for Drawn Aluminium Profiles. —— Kienzle (*Aluminium*, 1937, 19, (9), 587–591).—Standard specifications.—A. R. P.

Construction of an Auxiliary High-Tension Overhead Cable. J. Beyerling (*Aluminium*, 1937, 19, (10), 640–642).—The erection of a 100-kv. overhead cable of aluminium alloy is described, with special reference to the method of suspension.—A. R. P.

Suspension Tests on Steel-Cored Aluminium Overhead Conductors. Paul Behrens and Helmut Hutter (*Aluminium*, 1937, 19, (10), 643–645).—Vibration tests and determinations of the effect of temperature on the degree of sag in free transmission lines of steel-cored aluminium gave results which indicate that the elastic modulus and coeff. of expansion of modern stranded cables are sufficient to meet all demands made on the cables in service.—A. R. P.

Inductance of Steel-Reinforced Aluminium Cable. L. F. Woodruff (*Elect. Eng.*, 1935, 54, (3), 296–299).—S. V. W.

The Use of Aluminium for Lightning Conductors. B. Walter (*Z. tech. Physik*, 1936, 17, (1), 17–19).—Aluminium is compared with copper and iron as a material for the construction of lightning-conductors, and the optimum diameter of rods of the different metals calculated on the basis of a formula given by Vogel.—C. E. R.

Acoustic Diaphragms [of Aluminium–Magnesium Alloy]. E. E. Halls (*Machinery* (*Lond.*), 1937, 51, (1306), 70–71).—The aluminium–magnesium alloy MG7, as sheet 0·003 in. thick, is used for constructing ribbed telephone and similar acoustic diaphragms, where stiffness combined with light weight are essentials. Blanking, heat-treatment, flattening, and finishing operations are briefly described.—J. C. C.

Road Vehicles of Light Metal—a Contemporary Survey. Heinz Brauer (*Automobiltech. Z.*, 1937, 40, (17), 425–430).—Light metal construction is reviewed, with special reference to the exhibits at the International Automobile Exhibition, 1937. The increasing use of light metal for heavily-stressed parts is discussed in its relation to the design and running properties of vehicles. The relative merits of riveted and welded joints are shown to depend largely on the position of the joint in relation to the neutral axis and the stiffening members.—P. R.

Light-Weight Rolling Stock. A. H. Woolen (*Rail. Gaz.*, 1936, 64, (13), 605–606).—Abstract *in extenso* of a review by W. in *Rail. Age* (*U.S.A.*) of 13 years' experience of rolled and extruded light alloys in railway coach construction in the U.S.A.—P. R.

Light Metal Construction for Gliders. L. Roth (*Jahrb. Lilienthal-Ges. Luftfahrt.*, 1936, 537–548).—The increased use of light alloys in the less heavily stressed parts of gliders is advocated. The design of certain units, especially of riveted construction, is discussed and illustrated.—P. R.

Use of Aluminium in the Manufacture of Tools for Wood-Working. P. S. Afanasiev (*Legkie Metally* (*Light Metals*), 1937, 6, (2), 24–26).—[In Russian.] A list of tools and machine parts for which aluminium and its alloys may be used.—D. N. S.

Light Metal Instead of Nickel Silver. Hellmuth Fischer (*Aluminium*, 1937, 19, (5), 321–322).—The construction of a military clasp out of Silal V instead of nickel silver is described.—A. R. P.

Aluminium Foil for Condensers. V. T. Rennie (*Legkie Metally* (*Light Metals*), 1937, 6, (4), 22–25).—[In Russian.] A review, and comparison, of the compositions and properties of aluminium foils.—D. N. S.

Advantages of Alloys of the Silumin Type, and the Possibilities of Their Use in the Foundry. J. A. Zenter (*Legkie Metally* (*Light Metals*), 1937, 6, (5/6), 3–6).—[In Russian.] A review.—D. N. S.

Modifications of Copper for Fire-Box Plates. —— Chan (*Cuivre et Laiton*, 1937, 10, (201), 273–277).—From *Rev. gén. Chemins de Fer*, 1936, **55**, 331–338; see *Met. Abs.*, 1936, **3**, 280.—W. A. C. N.

Special White Cast Irons and Cupro-Nickel Containing Tin for Acetylene-Welded Coatings. M. Ballay and R. Chavy (*Congrès internat. Fonderie, Paris* (*Preprint*), **1937**; and *Rev. Nickel*, 1937, 8, (5), 145–150).—The characteristics of alloys suitable for the hard-facing of ferrous and non-ferrous materials are reviewed; the composition, hardness, and conditions of application of a variety of such alloys are described. Non-ferrous materials include Stellite and a range of cupro-nickels containing varying proportions of tin and silicon: suitable compositions for use on Monel, mild steel, and cast-iron bases are tabulated.—P. R.

Modern Bronze Alloys. —— (*J. Commerce* (*Ship Eng. Edn.*), **1937**, (Oct. 28), 1).—Recent metallurgical developments are discussed, and consideration is given to the use of copper–zinc–aluminium alloys for condenser tubes, leaded–bronzes alloyed with nickel for bearings, copper–silicon and copper–silicon–manganese alloys for high-duty castings, and copper–nickel alloys for corrosion-resistance. The properties of these alloys are considered with reference to the modifications produced by variations in the composition, and special consideration is given to high-temperature conditions and to the suitability of nickel–bronzes for such conditions.—J. W. D.

Requirements of Materials for Weaving Fourdrinier [Paper-Machine] Wires. Hugh E. Brown (*Wire and Wire Products*, 1936, **11**, (1), 15–18, 54).—See *Met. Abs.*, 1936, **3**, 738.—S. G.

Furukawa Bimetal No. 1. —— (*Furukawa Denko* (*J. Furukawa Elect. Co.*), **1937**, (4), 98–103; and *Kikai* (*Machinery*), 1937, **10**, (5), 34–36).—[In Japanese.] Furukawa Bimetal No. 1 corresponds to Chase Bimetal No. 1800, consisting of brass and Invar strips. The service temperature is from − 40° to 150° C.—S. G.

***Vacuum Lead Sheath as Applied to Power Cable.** R. W. Atkinson (*Wire and Wire Products*, 1936, **11**, (12), 695–704).—A clear account is given of the appearance and causes of flow lines, tongue patterns, and welds in lead cable-sheath during its extrusion from a vertical cable press. It is suggested that these may be produced as a result of gas inclusions, as well as oxide films between successive lead charges. Methods of operating a press so that the lead is maintained under vacuum are described. Photographs of etched sections of sheath made in this equipment show no areas of fine grain structure and no oxide inclusions. In internal pressure-bursting tests at 60° and 40° C., giving stresses of 540 and 445 lb./in.^{2} in the lead, the time taken for failure was, on the average, nearly twice as long with vacuum as with non-vacuum sheath. Bending tests on slit rings cut from the sheath showed a weakness in the neighbourhood of the weld in normal sheath, whereas in vacuum sheath the strength was uniform at all points on the circumference.—J. C. C.

Telecommunications in Germany. —— (*J. Télécommunications*, 1936, 3, (5), 138–145).—Brief reference is made to the commencement of tests with a lead–tellurium alloy as a cable sheath, and to a machine of German invention for splicing the conductors of two cables.—R. T.

Magnesium and Its Present Importance as a Constructional Material. H. Koch (*Metallwirtschaft*, 1937, 16, (45), 1165–1166).—The composition, properties, and uses of some commercial magnesium alloys are discussed.—v. G.

A Draft Table for Standards for Magnesium Alloys. J. E. Afanasiev (*Aviopromishlennost* (*Air Ind.*), 1936, (7), 12–17).—[In Russian.] The table gives a list of magnesium alloys showing compositions, heat-treatment, mechanical properties, and sp. gr.—N. A.

The Use of Nickel in Automobile Engineering. W. J. Lee-Bird (*Nickel Bull.*, 1937, 10, (8/9), 169–173).—S. G.

Nickel and Its Alloys in the Production and Refining of Petrol. Jacques Lasneret (*Rev. Nickel*, 1937, 8, (4), 116–123).—Read at the 11e. Congrès Mondial du Pétrole, Paris, 1937. Nickel is used as an alloying material in the special steels required in drilling and in pumping; ferrous alloys of nickel are again much used in refinery plant, but nickel-plated steel and Monel metal are in general use where high resistance to sulphide corrosion is essential. " Monel K " is used in shafts, piston rods, and in pumps treating acid sludges. —P. R.

Nickel [Alloys] in the Manufacture of Glass. —— (*Rev. Nickel*, 1937, 8, (5), 151–153).—See *Met. Abs.*, this vol., p. 421.—S. G.

Castings in Monel and Pure Nickel. —— (*Monel Notes*, 1937, (5), 67–69).—S. G.

Mechanical Properties of Monel Metal Turbine Blades. Rudolf Müller (*Tech. Zent. prakt. Metallbearbeitung*, 1937, 47, (13/14), 557–560; (15/16), 629–632).—In all kinds of vessels Monel metal is being increasingly employed for turbine blades, on account of the higher speeds and the resulting greater pressures and stresses which the blades have to withstand. The requisite physical properties of such material are discussed, and illustrative examples given. The comparative merits of taking tests of the original stock and of the completed blade are reviewed. Creep at 350° and 400° C. has been studied. —W. A. C. N.

Pickling: Use of Monel in the Construction of Pickling Plant. Jacques Picard (*Rev. Nickel*, 1937, 8, (5), 135–144).—The physical, chemical, and mechanical properties of Monel metal are discussed, with reference to its suitability for use in the construction of vats, chains, crates, lifting gear, and other pickling plant. The susceptibility of Monel metal, cupro-silicon, pure nickel, and aluminium bronze to sulphuric acid attack is compared graphically. Structural details of vats and crates are illustrated, and the weight and strength of Monel metal parts are compared with those of corresponding pieces in other materials, *e.g.* lead–bronze.—P. R.

Monel Pumping and Control Equipment. —— (*Monel Notes*, 1937, (4), 51–54).—S. G.

[Monel Metal for] Engineering Valves. —— (*Monel Notes*, 1937, (6), 83–87).—Briefly indicates some uses of Monel metal in the construction of valves. —S. G.

Scope of Monel Metal in Dyeing and Finishing. F. Scholefield and H. A. Turner (*Textile Manuf.*, 1937, 63, (747), 119–120; (748), 164–165; (749), 206–207; and *Monel Notes*, 1937, (6), 90–92).—S. G.

Monel in the Paper and Pulp Industry. —— (*Monel Notes*, 1937, (5), 74–76).—S. G.

A Problem in Ethyl Chloride Manufacture. [Use of Monel Metal.] —— (*Monel Notes*, 1937, (6), 93).—Monel metal is being used successfully for high-pressure valves and safety valves and fittings for autoclaves used in the manufacture of ethyl chloride.—S. G.

[Monel Metal and Nickel in] Caustic Soda Evaporators. —— (*Monel Notes*, 1937, (4), 60–61).—S. G.

[Use of Monel Metal in] Light Oil Refining. —— (*Monel Notes*, 1937, (3), 44–45).—S. G.

Resisting Hydrochloric Acid Corrosion. —— (*Monel Notes*, 1937, (3), 42–43).—Briefly discusses applications of Monel metal and nickel.—S. G.

[Monel Metal] Piping Systems. —— (*Monel Notes*, 1937, (1), 11–12).—S. G.

Uses of Monel and Nickel in Gas Manufacture—By-product Coke—Light Oil Refining. —— (*Monel Notes*, 1937, (2), 24–25).—S. G.

The Use of Nickel and Monel in Flow Meters. —— (*Monel Notes*, 1937, (2), 27–29).—S. G.

Monel Plywood. —— (*Monel Notes*, 1937, (3), 35).—Monel plywood consists of a sheet of the alloy backed by a sheet of plywood, adhesion being obtained by special cements and very high pressures. It can be supplied covered on one or both sides. For the purposes for which it is recommended, Monel plywood is said to be as corrosion-resistant as the alloy itself.—S. G.

Some Recent Applications of Bimetallic Strip. R. E. Ansell (*Nickel Bull.*, 1937, **10**, (10), 206–209).—For linear relationship, the low-expansion characteristics of the 36% nickel–iron alloy are limited to temperatures below 200° C. For the temperature ranges up to 250° and 350° C., the 39% and 42% nickel–iron alloys, in combination with suitable high-expanding alloys, are respectively suitable. The applications of bimetallic strip for various thermostatic devices are described.—J. H. W.

Precious Metals and Their Uses. P. G. Smyrk (*Jeweller and Metalworker*, 1936, **62**, (1515), 1082, 1084, 1087).—Summary of a paper read before the Hull and District Branch of the N.A.G.—L. A. O.

" Batalum," a Barium Getter for Metal Tubes. [Use of Tantalum.] E. A. Lederer and D. H. Wamsley (*R.C.A. Rev.*, 1937, **2**, (1), 117–123).—The functions and development of " getters " and the uses of " Batalum " as a " getter " for metal wireless valves are described. " Batalum " is a tantalum wire in the form of a single helical coil, on which are sprayed the double carbonates of barium and strontium, the whole being mounted in a shield.
—E. V. W.

***The Tin Content of English Canned Fruits and Vegetables.** W. B. Adam and G. Horner (*J. Soc. Chem. Ind.*, 1937, **56**, (9), 329–334T).—Tests made on numerous fruits and vegetables preserved in lacquered tin cans showed that, even after prolonged storage, the contents of the cans rarely contained more than 40 mg. of tin per kg., and were therefore quite harmless, especially as less than half the tin was in a soluble form.—A. R. P.

Metallurgy and the Aero-Engine. D. R. Pye (*J. Inst. Metals*, 1937, **61**, 19–34).—Autumn Lecture, 1937. The remarkable increase of recent years in the power of aero-engines has been largely due to improvements in the quality of the fuel available, but it could not have been achieved without many parallel improvements of a metallurgical character. The increase of power has involved thermal and mechanical problems, and of the former, those associated with the piston and exhaust valve are the most formidable. On the mechanical side, the problem is that of maintaining two surfaces at high temperatures rubbing without seizure. It is of importance to consider what treatment of the metal surfaces themselves will render them less liable to seizure when

the lubricant can no longer provide sufficient protection. Metal surfaces, normally crystalline in their atomic structure, can in some circumstances be rendered amorphous, and there are reasons for thinking that in this state they form more satisfactory bearing surfaces. A study of the ultimate structure of metal surfaces, such as is provided by the physicist, may be expected to afford valuable assistance in the engineer's problem of bearing surfaces.
—D. R. P.

Molecular Forces in Friction and Boundary Lubrication. N. K. Adam (*Inst. Mech. Eng. General Discuss. on Lubricants, Advance Copy*, **1937**, (Group IV), 1–5).—A theoretical consideration is given of the mechanism of friction and lubrication. The conditions for, and an explanation of the action of "seizing" of metal surfaces are described. The rôle of a "boundary" film of lubricant is explained and the requirements for the permanent preservation of this film is indicated.—R. Gr.

Some Observations on the Effect of a Number of Added Substances on the Lubricating Properties of Oils. H. W. Brownsdon (*Inst. Mech. Eng. General Discuss. on Lubricants, Advance Copy*, **1937**, (Group IV), 58–64).—Consideration is given to the effect of additions to a mineral oil used to lubricate the frictional surfaces in a Brownsdon wear machine. Tests on 70 : 30 brass in contact with a hardened-steel wheel are recorded in tabular form, and a general discussion thereon is given.—R. Gr.

***Oiliness in Relation to Viscosity.** A. W. Burwell and J. A. Camelford (*Inst. Mech. Eng. General Discuss. on Lubricants, Advance Copy*, **1937**, (Group IV), 65–78).—The results of tests on a Moore–Carvin apparatus are given of the effects of treating an oil with a finely-divided metal, such as lead, copper, iron, by hydrogen or zinc. Saponification determinations on treated and untreated oils indicated that a selective segregation of polar bodies to the metal surfaces occurs, which exerts a pronounced influence upon the behaviour of lubricating oils. It is concluded that the characteristics of a lubricating film are determined by the relative attraction for the metals comprising the bearing of each component of the mixture comprising the lubricant.—R. Gr.

***The Adsorption of Oils in Relation to Lubrication.** J. J. Trillat (*Inst. Mech. Eng. General Discuss. on Lubricants, Advance Copy*, **1937**, (Group IV), 196–206).—The strength of adhesion, W_{MH}, between a metal and oil can be calculated from Dupré's formula, $W_{MH} = \gamma_H (1 + \cos\theta)$, where H is the surface tension of the oil and θ the angle of contact of oil and metal. T. describes a method whereby the number of molecules adsorbed and the thickness of the boundary layer may also be calculated.—R. Gr.

The Surface Condition of Metals. H. Brillié (*Mécanique*, 1937, **21**, (274), 217–219).—Contribution to a discussion by the Société française des Mécaniciens. The influence of surface condition on lubrication requirements is discussed.—P. R.

Problems of Metallic Materials for Internal-Combustion Engines. Shiro Ishida (*Kikai oyobi Denki* (*Mech. and Elect. Eng.*), 1937, **2**, (1), 189–193).—[In Japanese.] Deals with high-grade cast iron, high-strength steel, surface-hardening, heat-resisting steel, light alloys, bearing alloys, and the endurance of materials.—S. G.

Metallurgical Needs of the Glass Industry. R. D. Smith (*Metals and Alloys*, 1936, **7**, (9), 217–220; (10), 263–267; discussion, 267–268; and *Glass*, 1937, **14**, (3), 88–91; (4), 136–139).—S. V. W.

†Centrifugal Casting of Non-Ferrous Metals and Its Importance in the Economizing of Foreign Raw Materials. H. Roeder (*Metallwirtschaft*, 1937, **16**, (28), 703–704).—The structure and tensile properties of sand castings and centrifugal castings of bronze and red brass are compared.—v. G.

The Selection of Wire Spring Materials. J. W. Rockefeller, Jr. (*Wire and Wire Products*, 1936, **11**, (10), 521–523, 526, 592–593).—The characteristics of the principal materials used for spring-making and their applications are outlined. The non-ferrous spring materials include phosphor–bronze, spring brass, Monel metal, nickel silver, and beryllium–copper.—J. C. C.

†**Age-hardening Alloys and Their Applications.** R. H. Harrington (*Gen. Elect. Rev.*, 1936, **39**, (3), 124–127).—The characteristics of the process of age-hardening are described briefly, and illustrated by certain of the well-known examples. Some examples are given of useful age-hardening alloys; these include the iron–nickel–aluminium alloys used for permanent magnets, and the copper–beryllium and copper–cobalt–beryllium alloys, which are proving very useful in various branches of electrical engineering.—S. V. W.

Standardization in the Non-Ferrous Metal Industry During the Past Year, and the Outlook for 1937. A. I. Glembozky (*Vestnick Standartizazii* (*Messenger Standardization*), **1937**, (2), 8–14; (4), 19–26).—[In Russian.] A review.—N. A.

XXII.—MISCELLANEOUS

(Continued from pp. 567–569.)

A. Wilm and the Discovery of Duralumin. —— (*Aluminium*, 1937, **19**, (8), 511–522).—Some of Wilm's original researches are reprinted, and illustrated with coloured graphs and diagrams.—A. R. P.

Death of Alfred Wilm—Inventor of Duralumin. —— (*Light Metals Research*, 1937, **5**, (24), 546–547).—Obituary.—S. G.

The 1937 Bessemer Medallists, Colonel N. T. Belaiew and M. Aloyse Meyer. —— (*Rev. Mét.*, 1937, **34**, (7), 397–398).—A note on the life and work of N. T. Belaiew and A. Meyer.—H. S.

Raw Material Reorganization in the German Metal Industry. Hansheinrich Pontani (*Metallgesellschaft Periodic Rev.*, 1937, (**12**), 23–32).—[In English.] A summary, including examples from industry, of the measures taken in the reorganization of the use of German domestic raw materials. The principal substitutes dealt with are Silumin, the Zamak alloys, lead-bearing metals, and the Parkerizing and Bonderizing processes.—W. A. C. N.

The Non-Ferrous Metals in 1936. Metallgesellschaft A.-G. (*Aluminium*, 1937, **19**, (9), 625–630).—Statistical; contains production and consumption data for 1936 and comparative figures for earlier years.—A. R. P.

Names of Metals and Alloys. Th. Wolff (*Metallwirtschaft*, 1937, **16**, (44), 1129–1133).—The origin and meaning of the names of all metals and of the most important alloys are given.—v. G.

Development of Aluminium Economies in the World Since the Turn of the Century. Alfred Dederer (*Aluminium*, 1937, **19**, (3), 210–214).—A statistical survey of the growth of the aluminium industry in the most important countries of the world during the last 40 years.—A. R. P.

Antimony in Capitalist Countries. E. P. Libman (*Redkie Metally* (*Rare Metals*), 1937, **6**, (1), 40–45).—[In Russian.] A review, with statistics.—D. S.

Cæsium. A. P. Sosedko (*Redkie Metally* (*Rare Metals*), 1937, **6**, (2/3), 46–47).—[In Russian.] A review.—D. N. S.

Copper Industry. H. Foster Bain and Wm. G. Schneider (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1020–1025).—The history, occurrence, mine production, reduction processes, grades, refining processes, prices, and distribution of uses are briefly dealt with, and the estimated uses of copper in the U.S.A. from 1925 to 1934 are tabulated.—S. G.

***Chemical Investigations of the Ancient Metallic Implements in the Orient. VII—, VIII—, IX—. On the Ancient Chinese Copper Implements. (6), (7).** Tsurumatsu Dono (*Nippon Kwagaku Kwai Shi* (*J. Chem. Soc. Japan*), 1936, **57**, (1), 59–63; (2)).—[In Japanese.] (VII.—) A review of the results of chemical analysis. (VIII.—) Deals especially with the existence of the Copper Age in China. (IX.—) Discusses the transitional period between the Copper and Bronze Ages in China.—S. G.

***The Metallurgy and Technology of Gold and Platinum Among the Pre-Columbian Indians.** Paul Bergsøe (*Ingeniørsvidenskabelige Skrifter*, 1937, [A], **44**, 45 pp.).—[In English.] The subject of investigation is a collection of small articles of gold and platinum from Ecuador. Reference is made to earlier work by T. Wolf. Most of the objects have been found when panning for gold. They are finely wrought, and show evidences of marked metallurgical ability. Of Pre-Columbian age, most of the specimens show signs of European mediæval influence. When platinum was separated from the gold it was done by sorting; the gold was then alloyed with copper. Most of the small utensils found had been hammered, and then welded—by first causing exudation of the eutectic. A *bibliography* is included. [*Note by abstractor:* Photomicrographic evidence would have given very interesting and authoritative supplementary information.]—W. A. C. N.

The Lead Industry. F. E. Wormser (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1148–1153).—Deals with the history, minerals, mining, melting and refining, grades, sellers, prices, and uses of lead.—S. G.

[Occupational Diseases.] A. S. Gray (*Rep. Bur. Occupational Diseases, Connecticut State Dept. Health, for 1935*, **1936**, 411–462).—Ten pages containing numerous figures on results found in practice are devoted to the control of foundry dust. Detailed recommendations for reducing silicosis are given. Lead poisoning may be diminishing, but exposures are not. Casters of lead were shown in a tabulation not to be endangered. Temperatures of melting pots $> 900°$ F. ($> 482°$ C.) volatilize lead in dangerous and rapidly increasing quantities. Fluxing of a type metal produced 481 times the safe limit of 1·5 mg. lead/10 m.^{3} of air, the intermittency of exposure reducing the operator's average day's exposure to 3·7 times the safe limit. Hot aluminium castings dipped into nitric acid at 18° to 43° C. gave but 1·7 to 2·2 p.p.m. of nitrogen oxide to the air at one place. For tanks in which trichlorethylene is used it was suggested that cooling coils to condense the vapour could protect the worker if draughts across the tank were prevented.—S. G.

***The Action of Lead on Workers in Various Occupations.** R. Naevestad (*Tids. Norske Laegeforening*, 1936, **56**, 453–473).—An examination was made of 300 workers in lead. The investigation showed that the risk of lead poisoning must be considered greatest among lead-burners, workers in accumulator factories and lead foundries, and those preparing and handling dry lead paints.—S. G.

Lead Poisoning in France According to Official Statistics. A. Feil (*Press méd.*, **1937**, 32; *J. Indust. Hyg.* (*Abs.*), 1937, **19**, 84).—The number of cases of lead poisoning (which has steadily decreased) was 674 in 1934 as compared with 1525 in 1928. There were 66 cases in lead foundries.—S. G.

Magnesium Industry. W. G. Harvey (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1192–1196).—Deals with the history, minerals, production methods, forms, alloys, fabricating methods, and uses of magnesium, with some statistics of the production of ingots and stick, and structural and non-structural products in the U.S.A. in 1930–1934.—S. G.

Magnesium Alloys in German Patent Literature. J. Jaisle (*Metallwirtschaft*, 1937, **16**, (45), 1163–1164).—A summary of all German patents covering compositions of magnesium alloys.—v. G.

***The Escape of Mercurial Vapours in Workshops. Study of Methods for the Control of These Vapours.** A. N. Lvoff (*Med. du travail*, 1937, **9**, 4–25).—Discusses two methods studied by L. for the control of mercury vapours in air.—S. G.

Principal Tendencies in the World Molybdenum Industry. E. Petrovich (*Redkie Metally* (*Rare Metals*), 1937, 6, (1), 46–48).—[In Russian.] A review. —D. N. S.

The Nickel Industry. A. J. Wadhams (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1236–1239).—Deals briefly with ores, smelting and refining, and uses, and gives 9 references.—S. G.

Niobium. E. Petrovich (*Redkie Metally* (*Rare Metals*), 1937, 6, (2/3), 48–49).—[In Russian.] A review.—D. N. S.

The Tin Industry. R. L. Hallett (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1284–1288).—Briefly deals with the history, sources, occurrence, mining and metallurgy, prices, uses, and international control of tin, and gives tables of world production (1925–1934), prices (1930–1934), world consumption (1927–1934), and virgin tin consumed in the U.S.A.; another table gives the names of brands, with their compositions.—S. G.

The Zinc Industry. C. S. Trewin (*Metals Handbook* (*Amer. Soc. Metals*), **1936**, 1322–1325).—Deals briefly with history, occurrence, production processes, grades and forms, prices, and uses, with 11 references.—S. G.

***Zinc Vapour Poisoning (Metal Fume Fever). Clinical Observations and Therapy.** F. Chrometzka (*Deut. Arch. klin. Med.*, 1937, **179**, 569–576; *J. Indust. Hyg.* (*Abs.*), 1937, **19**, 110).—Observations were made on workers who welded zinc (or galvanized plates) electrically.—S. G.

***Contribution to the Sources of Error in the Manufacture of Sections.** F. Roll (*Metallwirtschaft*, 1937, **16**, (46), 1179–1184).—Errors can arise owing to deformation or overheating of the surface, to the formation of nitrides or oxides during polishing, and to incorrect etching (production of " superstructures "). Some characteristic examples are shown.—v. G.

Report of the Materials Committee [of the Lilienthal Gesellschaft]. W. Müller von der Heyden (*Jahrb. Lilienthal-Ges. Luftfahrt.*, **1936**, 614–619).—The work of the Groups dealing with: crankshafts; welding cracks; exhaust fittings; valve steels; valve springs; pistons, piston rings, cylinders and cylinder heads; Duralumin; Elektron; aluminium–magnesium alloys; and non-destructive testing methods is reported.—P. R.

Contribution to Recent Developments of Electrometallurgy and Allied Electrochemical Process in the United States. Georg Eger (*Metall u. Erz*, 1937, 34, (16), 421–432).—Recent American progress in the recovery of electrolytic zinc and copper direct from ores, in the galvanizing of iron wire, and in the recovery of various metals from scrap by electrometallurgical and electrochemical processes is described.—A. R. P.

Developments in the Electrical Industry During 1936. John Liston (*Gen. Elect. Rev.*, 1937, **40**, (1), 5–63).—*Welding.*—The use of thyratron control for spot- and seam-welding of high-strength aluminium alloys used in aircraft construction is mentioned. A fractional-horsepower motor used in conjunction with a magnetic clutch has been developed for the accurate timing of spot-welds over a range of from 3 to 40 cycles. A new arc-welding equipment employs rectifying valves instead of rotating equipment. *Industrial Furnaces.*—The use of controlled-atmosphere electric furnaces for the bright-annealing of steel strip, copper wire, and tubing continues to increase. Similarly with copper-brazing furnaces. *Research.*—Reference is made to a new contact tip material made from a pressed and sintered mixture of silver and lead oxide plus a little molybdenum.—S. V. W.

Development and Research Works of the Siemens and Halske A.-G. III.—Development of Materials and Components. K. Reche (*Veröff. Nachrichtentechnik*, 1937, **7**, (2), 233–243).—This survey of recent work includes the development of magnetic materials for loading coils (iron–nickel alloys and Sirufer), of alloy " 1040 " (iron–nickel–copper) for high permeability sheet and tape, and of various permanent-magnet alloys, such as aluminium–

nickel steels, titanium(–nickel–cobalt) steels, and an alloy containing nickel 20, iron 12, and copper 68%. Reference is made to the surface improvement of metals by the Elytal and Eloxal processes. Electrochemical production and refining of metals and the development of electric arc and induction furnaces are briefly reviewed.—R. T.

Research as Applied to Manufacturing. C. W. Meyers (*Wire and Wire Products*, 1936, **11**, (10), 561–564).—The organization, aims, and conduct of an industrial research laboratory are discussed.—J. C. C.

XXIII.—BIBLIOGRAPHY

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*__Hoar, T. P.__ *The Corrosion of Tin in Nearly Neutral Solutions.* (Technical Publications of the International Tin Research and Development Council, Series A, No. 63). Med. 8vo. Pp. 16, with 8 illustrations. 1937. London: International Tin Research and Development Council, 378 Strand, W.C.2. (Gratis.)

[Reprinted from *Trans. Faraday Soc.*, 1937, 33, 1152–1167; see *Met. Abs.*, this vol., p. 515.]

*__Institution of Automobile Engineers.__ *List of Members.* October, 1937. Demy 8vo. Pp. 159. 1937. London: The Institution, 12 Hobart Place, S.W.1. (2*s.* 6*d.*)

*__Jones, W. D.__ *Principles of Powder Metallurgy, with an Account of Industrial Practice.* Demy 8vo. Pp. xii + 199, with 73 illustrations. 1937. London: Edward Arnold and Co. (15*s.* net.)

*__Jost, Wilhelm.__ *Diffusion und Chemische Reaktion in Festen Stoffe.* (Die chemische Reaktion. Herausgegeben von K. F. Bonhoeffer und H. Mark. Band II.) Med. 8vo. Pp. viii + 231, with 60 illustrations. 1937. Dresden und Leipzig: Theodor Steinkopff. (Geh., R.M. 20; geb., R.M. 21.)

*__Krause, H.__ *Galvanotechnik (Galvanostegie und Galvanoplastik).* Achte, ergänzte und verbesserte Auflage. 15 × 21 cm. Pp. viii + 275, with 21 illustrations. 1937. Leipzig: Max Jänecke. (R.M. 5.40.)

*__Le Chatelier, Henry.__ *Henry Le Chatelier. Discours prononcés a la séance solennelle du* 24 *Avril*, 1937. 18 × 23 cm. Pp. 77, with frontispiece. 1937. Paris: Gauthier-Villars.

*__Lead Industries Development Council.__ *Lead Burning in Architectural Work.* (Technical Publications, Bulletin No. 3.) Med. 8vo. Pp. 20, illustrated. [1937.] London: The Council, 38 King William St., E.C.4. (Gratis.)

*__Malette, Joseph.__ *La métallographie en couleurs appliquée à l'examen microscopique des métaux ferreux.* 13 × 21 cm. Pp. vi + 56, with 15 illustrations in the text and 2 colour plates. 1937. Paris: Dunod. (Br., 38 francs.)

*__Paterson, J. H.__ Edited by. *Handbook for Electric Welders.* Sixth Edition. Demy 8vo. Pp. 188, with 97 illustrations. 1937. London: Murex Welding Processes, Ltd., Ferry Lane Works, Forest Rd., E.17. (3*s.* net.)

***Pehrson, Elmer W., and H. M. Meyer.** *Lead.* (U.S. Department of the Interior, Bureau of Mines. Minerals Yearbook, 1937, Part II.) Med. 8vo. Pp. 171–190. 1937. Washington, D.C.: Superintendent of Documents. (5 cents.)

***Ritter, Franz.** *Korrosionstabellen metallischer Werkstoffe geordnet nach angreifenden Stoffen.* Med. 8vo. Pp. v + 193. 1937. Wien: Julius Springer. (Geb., R.M. 19.80.)

***Ruhemann, M. and B.** *Low-Temperature Physics.* Demy 8vo. Pp. ix + 313, with numerous illustrations. 1937. London: Cambridge University Press. (18*s.* net.)

***Séférian, D.** *High-Temperature Welding Flames.* Preceded by a Note on the Specific Heat of Gases at High Temperatures. Preface by G. Ribaud. Translated by N. F. Daniel. Roy. 8vo. Pp. 51, with 15 illustrations. 1937. London: Penton Publishing Co., Ltd. (3*s.* 9*d.*; 4*s.* post free.)

THESES.

***Jänische, Walter.** *Über das System Aluminium–Eisen–Silizium.* 21 × 30 cm. (Aluminium Archiv, Band 5.) Dissertation, Berlin Techn. Hochschule. 4to. Pp. 21, illustrated. 1936. Berlin: Aluminium-Zentrale, Abt. Literarisches Büro.

[See *Met. Abs.*, this vol., p. 593.]

***Krawczynski, Ursula.** *Über das System Wolfram-Kohlenstoff.* Dissertation, Tech. Hochschule, Breslau. 15 × 21 cm. Pp. 31, with 13 illustrations. 1936. Bückeburg: Hermann Prinz.

[See *Met. Abs.*, this vol., p. 619.]

XXIV.—BOOK REVIEWS

(Continued from pp. 573–580.)

Gases and Metals. An Introduction to the Study of Gas–Metal Equilibria. By Colin J. Smithells. Demy 8vo. Pp. vii + 218, with 145 illustrations. 1937. London: Chapman and Hall, Ltd. (18*s.* net.)

Those who have read Dr. Smithells' books and scientific papers know him to be a master of concise statement; in his latest book on "Gases and Metals" he has succeeded in condensing within the covers of a relatively small book an account of most of the important scientific work that has been carried out on gas–metal equilibria. The author has reviewed a large field, and has had to resort to a high degree of condensation in his treatment of many aspects of the subject: it is, indeed, doubtful if anyone else could have said so much in so few words. In spite of this concentration, Dr. Smithells has produced a very readable book. This is largely due to the systematic and logical treatment adopted in each section of the work, a commendable feature of which is the introduction, at an early stage in the treatment of each branch of the subject, of short illustrated descriptions of the principal experimental methods that have been used by many of the chief investigators.

The book is divided into three chapters, dealing, respectively, with adsorption, diffusion, and solution, each of which has been the subject of much study, and is important in a practical as well as theoretical sense. As the author points out in the preface, adsorption phenomena control many catalytic processes, and are important in the manufacture of vacuum devices, electric lamps, thermionic valves, and the like, whilst the diffusion of gases in metals, both liquid and solid, and the solubility of gases in metals, determine the success or failure of many metallurgical processes. The collection together, in one volume, of the general principles underlying adsorption, diffusion, and solution serves, however, an even more important object than the explanation of practical processes. It emphasizes the important parts which the phenomena of adsorption and diffusion play in influencing the passage of gas into and out of metals. Metallurgists, in particular, can be advised to read this volume, if only to satisfy themselves that many of the problems associated with gases in metals cannot be solved if treated merely as problems of solution alone.

Chapter I deals mainly with the phenomena and theories of adsorption and of activated adsorption and chemisorption, and with various other allied matters such as specific surface, the migration of adsorbed atoms, and catalysis. In Chapter II the laws of diffusion are reviewed, with particular reference to the effects of temperature and pressure; the importance of the conditions at the gas–metal interface is discussed, and the effects of structure, impurities, and other factors are considered; the chapter concludes with an interesting section dealing with the diffusion of nascent hydrogen. The final chapter deals with the laws of gas solubility, and the solubility of the common gases in metals and alloys: the effects of dissolved gases on the properties of metals are discussed, and the gases present in commercial metals are described. The theory of the removal of gases by heating a metal *in vacuo* is also dealt with.

In a work of this kind, where so much is condensed into a small space, any reader is likely to find that there is some section which, from his own particular point of view, is treated with less thoroughness than he would desire. Most metallurgists will probably regret that Dr. Smithells has not dealt at greater length with the sources of gases in metals, and in particular with the conditions of equilibrium of gases in molten metals and their escape during solidification, about which much is known. The work of N. P. Allen, for example, is dismissed in two lines and one figure. It might also have been expected that the theory of the use of "de-oxidizers" might reasonably have been dealt with in a work on gas–metal equilibria.

The book is well illustrated with 145 figures, and copious references are given in the text to original papers on the subjects dealt with. Apart from its intrinsic merits, which are many, the book is the only one dealing with this subject comprehensively; it should be in the possession of everyone interested in the study of metals.—D. Hanson.

Effect of Impurities in Copper. By S. L. Archbutt and W. E. Prytherch. With a Foreword by H. W. Brownsdon, and an Introduction by C. H. Desch. (British Non-Ferrous Metals Research Association, Research Monograph No. 4.) Med. 8vo. Pp. xvi + 134, with 44 illustrations. 1937. London: British Non-Ferrous Metals Research Association. (12*s.* 6*d.*; 13*s.* post free.)

The first major investigation undertaken by the British Non-Ferrous Metals Research Association after its foundation was a systematic study, carried out at the National Physical Laboratory, of the effects of impurities on the properties of copper. Starting with the purest obtainable cathode copper—oxygen-free high-conductivity copper was, of course, not then available—cast ingots for rolling were produced, and the properties of the rolled product were determined. Similar ingots were then made from the same copper, to which were added varying proportions of other elements, at first singly, and then in suitable combinations, and the effect of the additions on the rolling properties of the ingots and on the mechanical and physical properties of the hot- and cold-rolled rod was assessed. Between 1924 and 1935 a score or so of Reports were presented to the Association by the successive investigators, setting out the results with different elements, singly or together, and dealing with specialized aspects which arose in the course of the work, and eight papers, based on some of these Reports, were published in the *Journal of the Institute of Metals* between 1923 and 1931. This important Monograph, written by two of the later investigators, with the help and advice of former investigators and of colleagues at Teddington, and of the Association's staff, presents a summary and review of the whole of the work, and correlates its results with those of earlier and of contemporary workers in this field both in this country and abroad.

The book opens with a statement of the scope of the investigation and an account of the preparation, mechanical and other testing, and chemical analysis of the materials used. Examination of physical properties was made by density determinations on cast billets and on rolled rod and by electrical conductivity measurements on rolled rod. Mechanical properties investigated were tensile strength, elongation, and reduction of area of rolled rod; notched-bar impact (Izod) tests on rolled rod; fatigue tests on rolled rod; and reverse-bend tests on 0·03-in. thick strip annealed after cold-rolling. All these tests were carried out at room temperature. In addition, the softening of cold-rolled 0·05-in. thick strip on heating was followed by means of Brinell hardness tests, and for a special purpose Charpy notched-bar tests at ordinary and at elevated temperatures were used.

No very severe cold-working, such as is commonly applied to copper and its alloys in wire-drawing, was undertaken, and the book therefore contains no data on the behaviour of the various coppers when severely cold-worked or of their properties when drawn into hard wire; nor were any observations made of the effect of the impurities on the corrosion or on the oxidation and scaling behaviour of the materials.

The greater part of the book is devoted to a description of the effect of the following impurities (those elements or combinations of elements which formed the subject of investigations for the Research Association during these researches are shown in CAPITALS, those investigated for the Association by other investigators and in other laboratories in italics, and those examined independently of the Association only in ordinary type):—singly, OXYGEN, *hydrogen*, sulphur, IRON, PHOSPHORUS, *silicon*, BISMUTH, LEAD, ARSENIC, ANTIMONY, NICKEL, and silver; in pairs, *oxygen* and *hydrogen*, OXYGEN and BISMUTH, OXYGEN and LEAD, OXYGEN and ARSENIC, OXYGEN and NICKEL, ARSENIC and ANTIMONY, ARSENIC and BISMUTH, ANTIMONY and BISMUTH; three at a time, OXYGEN with ARSENIC and BISMUTH, with ANTIMONY and BISMUTH, with ARSENIC and NICKEL, and with ANTIMONY and NICKEL, respectively; and the more complex combinations OXYGEN, ANTIMONY, BISMUTH, and NICKEL, and OXYGEN, ARSENIC, ANTIMONY, BISMUTH, IRON, LEAD, and NICKEL. Grouped and discussed under these headings, all the test results obtained are set out in detail in numerous tables, which present an enormous amount of practical information conveniently arranged; there are over a score of photomicrographs illustrating structural features, and references to the literature, given at the end of each chapter, provide a representative and valuable bibliography.

No definition of the term "impurities" is given, but from the list above it will be clear that the impurities selected for investigation were primarily those most generally encountered in commercial coppers. Of those normally present in such coppers, selenium and tellurium alone are omitted; phosphorus, never present in copper except as the result of intentional addition, is dealt with, but not zinc, cadmium, manganese, tin, nor aluminium. The effect of silicon is briefly discussed, although no work on silicon as an *impurity* in copper was carried out for the Association in connection with these investigations, or is quoted from the literature; the discussion of copper–silicon *alloys* on pp. 43–45 does not, perhaps, fit very appropriately into the general scheme of the book. It is perhaps somewhat unfortunate that bismuth figures so prominently.

The chapter on bismuth and lead contains an inconclusive discussion of a type of brittleness encountered in some of the coppers after annealing.

After a short account of the segregation of impurities in cast copper ingots, the book ends with a valuable chapter in which the results for single impurities, and for certain impurities associated with a constant quantity of a second element, are summarized and compared graphically. The comprehensive and well-arranged index, which has come most satisfactorily through all the tests the present reviewer has applied to it, greatly facilitates reference to the contents of the book, and correspondingly enhances its value.

This Monograph must at once take its place as a work of reference indispensable to the metallurgist or engineer concerned with the production and use of copper for mechanical purposes, of high value to those who deal with the more specialized applications of high-conductivity copper to electrical engineering, and of great interest both to the general and to the academic metallurgist.—W. E. ALKINS.

A Comprehensive Treatise on Inorganic and Theoretical Chemistry. Volume XVI.—Pt and General Index. By J. W. Mellor. Med. 8vo. Pp. x + 811, with 94 illustrations. 1937. London: Longmans, Green & Co., Ltd. (63*s.* net.)

With the publication of this volume, the sixteenth of the series, the author completes a veritable labour of Hercules. Although one may criticize it in detail, the fact remains that it is a great achievement. With the speeding up of research and its industrial application, it becomes increasingly difficult to achieve perfection in a work of this nature, and it is not surprising therefore that, although the treatise was begun only 15 years ago, it has already been found necessary to plan two supplementary volumes for the purpose of bringing the information up to date.

Half of the present volume is devoted to platinum, and half to the general index. Those interested in the metals of the platinum group will regret that these metals have not been brought together in one volume, instead of being divided between two volumes, half of this volume and one-third of the previous one. Even the author, in the introduction to the group, says that they are "usually found together."

As in the preceding volumes, there is much space devoted to matters which are of interest to metallurgists. The sections on physical and mechanical properties and intermetallic compounds and alloys contain a lot of detailed information which will be very useful for reference. The information in these sections is also up to date, which, unfortunately, cannot be said of the section on the occurrence of platinum. There is no mention, for instance, of the fact that Canada now leads Russia in the production of platinum.

The sections dealing with the pure chemistry of platinum and its inorganic compounds, although excellent in their way, are of less interest to metallurgists.

The nomenclature which the author has adopted for the intermetallic compounds is not consistent, *e.g.* $PtPb_2$ is called platinum diplumbide; Pt_2Pb is called platinum tritaplumbide. The author is probably too ambitious in attempting to devise a nomenclature, as metallurgists who have most experience with these compounds have been content to use the formulæ alone (*cf.* Desch, Hume-Rothery).—R. H. ATKINSON.

Die Palladium–Silber–Edelmetallegierungen. Von Gerhard Tanzer. 15 × 21 cm. Pp. 64, with 32 illustrations. 1937. Dresden (A16): Hermann Puschel. (R.M. 4).

The introduction of alloys with a palladium–silver base into dental metallurgy to replace the more expensive gold-base alloys has necessitated several modifications in the dentists' technique; it is the object of this book to describe the methods of casting and working these alloys into palates, crowns, &c. No details are given of the composition or mechanical properties of the alloys, but sufficient information on the manipulation of the alloys is provided to enable dentists to make the best use of the alloys. The book contains 27 pages of illustrations and only 29 pages of text.—A. R. Powell.

Silver. An Analysis of Factors Affecting Its Price. By Y. S. Leong. Demy 8vo. Pp. xv + 152, illustrated. 1934. Washington, D.C.: The Brookings Institution. ($2.00.)

This little book contains a very careful statistical analysis and discussion of the factors which have influenced the price of silver since the beginning of this century. An amazing amount of data has been carefully sifted, classified, and tabulated, and numerous graphs are included to assist the reader in obtaining a clear idea of the effects of production, consumption, and politics on the price of the metal. The demand for silver is discussed under the headings of monetary demand, industrial demand, and the demand of India and China for silver for other purposes. The various sources of silver are described in detail with statistics of production where available, and finally the fluctuations in silver prices are compared with those in the wholesale prices of commodities in India and in New York. The book closes with 20 pages of statistical data arranged in tables, and with a selected bibliography; the text matter is also copiously annotated and contains numerous references.

Altogether the author has produced a stimulating work for all students of economics, and all those interested in the silver market; in spite of constantly changing conditions in the metal markets the book will always be found a valuable source of information.—A. R. Powell.

Hartmetallwerkzeuge. Wirkungsweise, Behandlung, Konstruktion, und Anwendung. Von Curt Agte und Karl Becker. Zweite, völlig neu bearbeitete Auflage. 15 × 21 cm. Pp. 234, with 144 illustrations. 1937. Berlin: Verlag Chemie G.m.b.H. (Geb. Lwd. R.M. 18; R.M. 13.50 to foreign purchasers.)

The appearance of the second edition of this book is very opportune. Although during the past two years no fundamental changes have taken place either in the technique of hard-metal manufacture or in the general methods adopted for its utilization as the active agent in cutting tools or as a wear-resistant material for innumerable special purposes, nevertheless significant progress has been made. Experience gained in consequence of the general broadening of the scope of hard-metal tools has been particularly fruitful; not only have relatively complex tool forms considered quite recently as purely of an experimental nature become permanently established (certain types of reamers, countersinking tools, and milling cutters, for example), but further valuable data have also been accumulated respecting simpler turning and boring operations. Whilst, therefore, the second edition of the book follows in broad outline the plan of the first, considerable modification has been made in Part VII, which, between pages 90 and 152, is devoted largely to a consideration of tools for the machining of metals. A more detailed classification of the various types of tools discussed has been adopted, new tool designs are noted, and there are more illustrations. In the absence of an English translation, this last feature is perhaps not least among the merits of the new edition. Owing to the lack of a rigidly standard English nomenclature, the interpretation of the German terms, even for the better-known types of tools, is sometimes a matter of no small difficulty; illustrations are self-explanatory and the more there are the better. Minor additions have been made to other sections of the book, and the list of patents and the bibliography have been been expanded. Finally a word of praise for the format, type, and binding. These are in no way different from those of the first edition, but lose none of their appeal when met with a second time.—W. D. Jones.

Métallurgie. Par R. Cazaud. (Agenda Dunod.) 58e. édition. 10 × 15 cm. Pp. cxxxi + 328, with 61 illustrations. 1937. Paris: Dunod. (20 francs.)

This is a new edition of a well-known pocket-book containing concise information on fuels, refractories, furnaces, mechanical testing, corrosion testing, metallographic examination heat-treatment, the metallurgy of the important elements, together with the usual series of tables. The information has, in most cases, been brought up to date.—W. A. C. Newman.

Réactifs d'attaque métallographique. Notions générales et formulaire relatifs aux réactifs micrographiques et macrographiques. Par A. Portevin et P. Bastien. 13 × 21 cm. Pp. xviii + 267, with 16 illustrations. 1937. Paris: Dunod. (Relié, 102.25 francs; broché, 87.25 francs.)

An important part of the metallographer's task lies in the selection of the most suitable etching reagent for the micrographic or macrographic examination of any particular material, and this volume by Professor Portevin and Dr. Bastien provides an extremely useful, handy work of reference for this purpose.

In a short introductory section the authors deal with some of the principles underlying the etching processes used in micrographic work. This is followed by two chapters dealing, respectively, with reagents for micrographic and macrographic etching of ferrous materials. These two chapters occupy about half of the book. Separate chapters are then devoted to the etching reagents for copper and copper alloys; aluminium, magnesium and light alloys; tin, lead, cadmium, bismuth and anti-friction metals, zinc and its alloys, nickel, chromium, and their alloys, and the precious metals. In a final section are included a few reagents for special purposes and some notes on grain-size measurements. A useful feature of the book is the three indexes; the first index gives materials examined (metals, alloys, or constituents), the second gives the etching reagents, and the third is an author index.

There appeared to be no book on this subject in the French language until the authors filled the gap with this valuable, practical handbook. It will be welcomed and used by English workers.—O. F. Hudson.

Hårdhetshandbok. Edited by P. E. Wretblad. (Svenska Metallografförbundet.) 18 × 24 cm. Pp. xvi + 331, with 81 illustrations. 1937. Stockholm: A. B. Nordiska Bokhandeln. (Bound, 18 Swedish crowns; card cover, 16 Swedish crowns.)

This is a comprehensive, technical review of hardness determination from the point of view of the metallurgist, chiefly that of the ferrous metallurgist. It surveys hardness theoretically and technically, beginning with chapters on the nature of hardness and its measurement before the work of Brinell.

One third of the text is then devoted to the Brinell method of testing, and the calculation of its results, citing investigations from all over the world. Swedish workers have contributed largely to this subject, Professor Benedicks and the editor of this book among them.

The volume then deals with dynamic and other hardness tests, compares the specifications for the Brinell test in U.S.A., Great Britain, and Germany, and appends 48 pages of tables for the calculation of hardness and the correlation of various hardness numbers.

Finally, a 74-page bibliography is included, which should be invaluable, and which closes with a note of the date of compilation—a useful detail which is too often omitted.—E. van Someren.

Die Zinkkorrosion betrachtet vom Standpunkt des Batterietechnikers. Von C. Drotschmann. 15 × 21 cm. Pp. ii + 46, with 4 illustrations. 1937. Ohlau in Schliesien: Dr. H. Eschenhagen. (R.M. 3.90; R.M. 2.90 to foreign purchasers.)

The scope of this booklet is limited, as the title suggests, but the author has achieved his object in that, within the narrow field of battery practice, he has given a useful survey of the chemical and electrochemical behaviour of zinc. The treatment is essentially practical, and is given a background of experiment.

The booklet describes the corrosion of zinc in aqueous solutions, with and without the passage of current, paying special attention to the action of atmospheric oxygen; the influence of lead, iron, arsenic, and cadmium as impurities in zinc; and the influence of casting conditions, heat-treatment, and mechanical treatment of the zinc. Special sections are devoted to the behaviour of amalgamated zinc, and the preparation, soldering, and service of zinc cups. Simple tests for the examination of zinc for batteries are described.—E. S. Hedges.

Protective Films on Metals. By Ernest S. Hedges. (Monographs on Applied Chemistry, edited by E. Howard Tripp. Volume V.) Second Edition. Demy 8vo. Pp. xv + 397, with 53 illustrations. 1937. London: Chapman and Hall, Ltd. (21*s.* net.)

The second edition of Dr. Hedges' well-known book, the original of which has given five years' useful service, will be welcomed by all who are interested in this subject. In revising his book, the author's chief aim has been to make it of greater value to industry, and to this end the space devoted to practical considerations has been doubled, and now extends to 190 pages, or roughly half the book. This expansion is the result partly of a more detailed treatment of some of the older methods of protection, partly to the number of new methods which have appeared during the last five years, and partly to the increase in the knowledge and application of some of those processes which were only in their infancy when the first edition was compiled.

The classification is the same as that adopted in the first edition, the different methods of protection being dealt with in seven chapters covering oxide and similar films, hot-dipped, electrodeposited, and sprayed coatings, cementation processes, miscellaneous coatings, and a final chapter on paints, lacquers, enamels, &c., which has been promoted from the appendix. Whilst it would be impossible to detail the many improved features of these chapters, attention is particularly directed to the concise account of the available methods for protection by anodic film formation and the very comprehensive survey of the modern theory and application of electroplating.

The most disappointing chapter is that devoted to hot-dipping. Of the 42 pages (excluding introductory matter) and 9 figures, tin has been favoured with 31 pages and all the figures. Consequently, as can be well imagined, it has been impossible in the remaining space to do justice to the other metals, zinc, in particular, suffering from inadequacy of treatment. One would have preferred a more general revision of this chapter, instead of the preferential treatment accorded to one section and the comparative neglect of the others. This, however, is but one small criticism, and the practical side of the book as a whole is extremely well done.

The theoretical portions remain substantially the same, with the inclusion of some of the more recent work on the study of the mechanism of corrosion, particularly in aqueous solutions. On this subject the main points of view held by the Cambridge and Teddington schools of thought are carefully explained.

Throughout the book a considerable amount of recently-published work is quoted, but this has been so moulded to a unity of form and composition that the danger of degenerating to a collection of abstracts has been avoided. References to original papers and patent literature, which have been limited in number by careful selection, are easily traced by their inclusion in the text.

Dr. Hedges is to be congratulated on accomplishing the difficult task of preparing this up-to-date and comprehensive compendium on the theory and practice of protecting metals. He is further to be congratulated on his lucid and pleasing style which has enabled him to present this mass of data in a most readable form. Here is an authoritative text-book and a standard work of reference, which should be read and consulted by all who are interested in the underlying principles or are concerned with practical problems relating to the protection of metals from corrosion.

A final word of praise must go to the publishers, the printing, paper, and binding being excellent.—L. KENWORTHY.

Beitrag zur Technik der anodischen Oxydation von Aluminium unter besonderer Berücksichtigung des Alumilite—Verfahrens. Von Johann Walter. (Dissertation: Eidgenössischen Technischen Hochschule, Zürich.) Demy 8vo. Pp. 100, with 23 illustrations. 1936. Zürich: Eidgenössischen Technischen Hochschule.)

The first 34 pages of this booklet describe the Bengough, Alumilite, Eloxal, Sheppard, and Siemens-Seo processes for anodic oxidation, giving brief particulars of the technique adopted in each process and the properties of the films produced. The chemical, electrical, and electrochemical mechanism of the oxidation is also discussed. The remainder of the booklet is devoted to a research on the variables of the Alumilite process and a comparison of the experimentally produced films with those obtained, in industry, by all the processes.

Test-pieces of pure aluminium were treated in 10, 20, 30, 40, and 60% sulphuric acid, varying, in turn, the current density, bath temperature, and time. The films produced were examined for appearance, hardness, insulating properties, corrosion-resistance, thickness, ductility, and absorption characteristics. A full description is given of the testing methods employed. Finally, a series of test-pieces of aluminium, Avional, Anticorodal, Peraluman, Aluman, Silumin, and 5% copper alloy were obtained from various firms, treated by various processes, and these were subjected to the same tests. A table of patent references concludes the booklet.

The results given must be of the greatest interest to all using the processes mentioned or products treated by them, and, indeed, should be read by all concerned in the corrosion of aluminium and its alloys.—H. W. G. HIGNETT.

The Canning Practical Handbook of Electroplating, Polishing, Bronzing, Lacquering, and Enamelling. Thirteenth Edition. Med. 8vo. Pp. x + 359, with numerous illustrations. 1937. Birmingham: W. Canning and Co., Ltd. (4*s.* 6*d.* post free.)

Every commercial plater in this country knows Canning's handbook on plating; if he does not he is about 40 years out of date. This book has been the standard work of reference among British platers for many years, and a new edition seems to be called for about every 3 years. In preparing these new editions, the editors take the opportunity to introduce notes on all the recent improvements in the plating art in so far as they have been *proved* to be of commercial value. In this thirteenth edition the section on nickel plating appears to have been thoroughly revised, and now includes notes on bright nickel-plating, the use of warm baths and continuous filters, automatic plating, determination of p_H, and black nickel-plating. The chromium plating chapter has been considerably amplified, and contains useful information on automatic plating, methods of suspending the work in the bath, and causes of failures and their prevention. The only criticism that can be made against the text in the plating sections is that the salts used in making up the bath are disguised under a proprietary name, but, of course, this is understandable in a book prepared to sell the products of the publishers.—A. R. Powell.

Weten. Galvanostegie en Galvanoplastiek. Handleiding voor het verkoperen, vernikkelen, verzilveren, vergulden enz. van metalen voorwerpen en voor het maken van afdrukken daarvan. By J. Hammes. Pp. 63, with 16 illustrations. Amsterdam: N.V. Uitgevers-Maatschappij, "Kosmos." 1937. (Fl. 0·75.)

A popular account of the electrodeposition of copper, nickel, gold, zinc, cadmium, and tin on other metals and on plaster and other non-metal substances. An adequate account is given of the sources of current, the apparatus, and the electrolytes, such as will enable the processes being carried out in the home. A chapter is added on the polishing and burnishing of the deposits.—James F. Spencer.

Die Chemische Emissions-Spektranalyse. III.—Tabellen zur Qualitativen Analyse. Von Walther Gerlach und Else Riedl. 15 × 23 cm. Pp. vii + 151. 1936. Leipzig: Leopold Voss. (Br., R.M. 6.)

To complete their work on spectrographic analysis, the authors have prepared tables of the most important lines of 57 metallic elements arranged in alphabetical order of chemical symbols. In these tables there are columns showing: (*a*) the elements which give lines of approximately the same wave-length as the given line, (*b*) the lines of other elements which interfere most seriously, and (*c*) control lines by means of which the intensities of these interfering lines can be estimated. By the judicious use of the information given in the tables, as explained in the text with reference to specific examples, it is possible to say with certainty whether an element sought is present even in traces. An appendix, supplied also as a loose copy, contains a list of the most important lines arranged in order of wave-length, together with the element which gives rise to them. The book is indispensable to all who have to do spectrographic analysis.—A. R. Powell.

Atlas der Analysen-Linien der wichtigsten Elemente. Von F. Löwe. (Zweite Auflage des "Atlas der Letzten-Linen.") 15 × 22 cm. Pp. iv + 37, with 3 line illustrations and 16 plates. 1936. Dresden u. Leipzig: Theodor Steinkopf. (Geb., R.M. 10.)

This is a revised and improved edition of the only moderately-priced atlas of spectra; it gives not the whole of each spectrum, but selected portions, beautifully reproduced in collotype. It consists essentially of plates illustrating the most useful lines for 46 of the chief elements, and a table of the wave-lengths of the lines of those 46 plus 11 rarer elements.

Like most German works on spectrum analysis, it refers to spark spectra rather than to arc spectra. Its great advance over the previous edition is that the lines enumerated are not only the most sensitive lines of each element, but also those most useful for quantitative analysis; for this reason the book will be of use to the metallurgical spectroscopist. The plates give a more vivid impression of spectrum lines than can be obtained from any tables of wave-lengths, but the fact that they are all from solutions sparked on carbon electrodes detracts from their value to the metallurgist.

It is noteworthy that one has to read at least six of the eight pages of introductory text in order to grasp the details of the tables, and it is unfortunate that the author should have apologized for the occurrence of aluminium as an impurity in his electrodes when in one quarter of the spectra calcium instead is conspicuous.—E. van Someren.

Chemische Analysen mit dem Polarographen. Von Hans Hohn. (Anleitungen für die chemische Laboratoriumspraxis. Herausgegeben von E. Zintl. Band III.) 14 × 21 cm. Pp. vii + 102, with 43 illustrations. 1937. Berlin: Julius Springer. (R.M. 7.50.)

In view of the growing interest in polarographic analysis and its extension to the analysis of alloys, this book has appeared at an opportune moment; it contains an excellent account of the principles of the method, detailed descriptions of the most recent apparatus and technique, and many examples of the practical applications of the process. The great advantages of polarographic methods for routine analyses are that several determinations can be made in the same solution without the necessity for making tedious separations, the time required for a determination is very short, very small quantities of material can be used, and the presence of small amounts of impurities is readily detected during the analysis. Among the applications of the method are the determination of impurities in aluminium and the analysis of brass and nickel silver; full details of these procedures are given. The book is exceptionally well produced, and the illustrations and graphs are beautifully printed; every analyst should possess a copy.—A. R. POWELL.

Neuere massanalytische Methoden. Von E. Brennecke, K. Fajans, N. H. Furman, R. Lang, und H. Stamm. Mit einem Vorwort von W. Böttger. Zweite neubearbeitete und erweiterte Auflage. (Die Chemische Analyse. Sammlung von Einzeldarstellung auf dem Gebiete der chemischen, technisch-chemischen und physikalisch-chemischen Analyse. Begründet von B. M. Margosches. Band XXXIII.) 16 × 25 cm. Pp. xiii + 234, with 18 illustrations. 1937. Stuttgart: Ferdinand Enke. (Geh., R.M. 22; geb., R.M. 23.60; 25% discount to foreign purchasers.)

The first edition of this bok which oappeared as recently as 1935 (see *Met. Abs.*, 1935, 2, 135) must have proved somewhat of a " best-seller " among specialized technical books for a second edition to be called for in the short space of 2 years. The authors have taken the opportunity to bring the text matter, and the copious references at the end of every section, right up to date. In addition, a new chapter, written by H. Stamm, has been included; this gives a lucid account of the most recent advances in permanganometry, viz. titration in alkaline solution, and many examples of the application of the method.

Although the size of the book has been increased by barely 10%, the price has been increased by about 25%, which scarcely seems justifiable in view of the apparently good sales in prospect.—A. R. POWELL.

Standard Methods of Analysis of Iron, Steel, and Ferro-Alloys. Revised and Enlarged Edition. Med. 8vo. Pp. 81. 1936. Sheffield: The United Steel Companies, Ltd., 17 Westbourne Rd. (4*s.* 6*d.*)

This little book contains detailed procedures for the determination of aluminium, arsenic, carbon, chromium, cobalt, copper, manganese, molybdenum, nickel, phosphorus, silicon, sulphur, titanium, tungsten, vanadium, and zirconium in steel and ferro-alloys, and for the analysis of Alsimin. The methods described are those used in the laboratories of the firms comprising the United Steel Companies; no description is given of the principles underlying the methods, the information given consisting simply of a list of instructions to the analyst in the well-known cookery-book style. As a whole the methods seem to be well chosen, although in some cases they are not the most rapid available. Undoubtedly the book will prove useful to steel chemists.—A. R. POWELL.

Aluminiumguss. Schwierigkeiten bei der Herrstellung und Wege zur Beseitigung. Von Max Schied. (Elsners Giesserei-Fachbücher, 6.) 12 × 16 cm. Pp. 79, with 50 illustrations. 1937. Berlin: Otto Elsner. (R.M. 1.50.)

The object of this little book is to point out the difficulties likely to be met with in aluminium foundry practice, and means of overcoming them. It is particularly intended for founders, experienced in the casting of heavier metals, who are embarking on light alloy work. It deals with the choice of sand, moulding technique, position of gates and risers, melting practice, and finishing. Within its limited compass it is excellent: it is clearly written, and describes not only the precautions which must be taken but the reasons for them.—H. W. L. PHILLIPS.

How to Build Up Furnace Efficiency. By Jos. W. Hays. Eighteenth Edition, Revised and Enlarged. Pp. xvi + 559, illustrated. 1936. Michigan City, Ind.: Dunes Publishing Co. ($3.00.)

This is the eighteenth edition of a book which offers the simple facts of combustion, examination of flue gases, the saving of fuel, draught control, and all those other problems which arise in the use of fuel-burning appliances, in a pictorial manner, enlivened by unusual methods of description. The book is intended for the fireman as well as the engineer, and the contents are presented in a form which makes their reading and assimilation interesting, amusing, and relatively easy. The author has proceeded on the assumption that basic facts may best be rammed home in non-technical language, which can be understood by the man who has to use the fuel. One has to admit that the book is very readable; that it has achieved its purpose in a large measure may be gauged from the fact that over 125,000 copies have been sold.—W. A. C. Newman.

Reinigen und Entfetten von Metallteilen. Ausgearbeitet vom Fachausschuss für Reinigen und Entfetten beim A. W. F. Herausgegeben vom Ausschuss für wirtschaftliche Fertigung (AWF) beim Reichskuratorium für Wirtschaftlichkeit (RKW). (R.W.K.—Veröffentlichungen, Nr. 91.) 15 × 21 cm. Pp. 135, with 33 illustrations. 1936. Berlin: Beuth-Verlag G.m.b.H. (R.M. 2.90.)

This little book contains an excellent account of modern methods of degreasing by means of alkali cleaners and solvent degreasers in liquid and vapour form. The necessary apparatus, including large automatic plants, is illustrated and described in detail; a description is also given of mechanical cleaners and of precautions to be taken to safeguard the health of the operatives. The book is well printed in a large clear type on good paper, and the numerous illustrations of apparatus are well reproduced.—A. R. Powell.

Chemische Färbungen von Kupfer und Kupferlegierungen. Eine Auswahl praktisch erprobter Arbeitsweisen mit 6 Farbentafeln. Folge I. Pp. 39. 1936. Berlin: Deutsches Kupfer-Institut E.V., Linkstrasse 19 (W 9).

Here is a useful collection of methods for producing coloured finishes, either matt or bright, on copper and copper alloys; both compositions and operating details are given for all colours from deep black to a rich chestnut brown, and the effects obtainable are illustrated by a number of coloured plates. A valuable feature of the book is an account of reasons for failure of the bath to work properly and hints on its proper maintenance. The preliminary preparation of the work and the final lacquering processes are also described.—A. R. Powell.

La Soudure Electrique à l'Arc. Par R. Sarazin. 2e. édition. 16 × 24 cm.. Pp. 493, with numerous illustrations. 1937. Neuilly-s./Seine: The Author, 47–49 Bd. de Levallois. (40 francs.)

The first six chapters of this book deal with the nature of the arc, and the design and operation of d.c. and a.c. generators. The next two chapters discuss carbon and metallic arcs for welding, and Chapter 9 consists of tables giving the characteristics (mechanical properties, volume of metal deposited, time to deposit, &c.) of the various "Fusarc" electrodes. In Chapter 10 are described the automatic welding heads and carriages developed by M. Sarazin. The next seven chapters deal with arc-cutting, the effects of gases on weld metal, and destructive and non-destructive tests on welded joints. Then follow a description of the Sarazin "tensiometer" and its application to determining internal stresses, two chapters on the training and supervision of welders, and five chapters on the welding of iron and steel. Chapter 25—of six pages—is devoted entirely to the non-ferrous metals. The remainder of the book describes many diverse applications of arc-welding in industry and gives a brief comparison of the process with oxy-acetylene.

The book presents the point of view of an enthusiast and deals primarily with the products of his own organization. The view is, however, backed by wide experience, and must be of interest to all engaged in arc-welding. The binding and printing are good, but there is no index.—H. W. G. Hignett.

Handleiding voor Accumulatoren, Lood, Ijzer-Nikkel, Cadmium-Nikkel (voornamelijk Automobiel en andere transportabele Accumulatoren). By Th. E. Maltha. 16 × 22 cm. Pp. 151, with 51 figures. The Hague: Bureau en Laboratorium Accutniek 'Gravenhage. (Fl. 3; bound, fl. 4.)

A simple detailed account of the theory, construction, and use of accumulator cells, particularly in connection with automobiles and other vehicles. The conditions of charging, discharging, and general upkeep are explained. The major portion of the book deals with the lead accumulator, whilst shorter sections are devoted to the iron–nickel cell (Edison cell) and cadmium–nickel cells.—James F. Spencer.