

## METALLURGICAL ABSTRACTS

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## APPOINTMENTS VACANT AND REQUIRED.

**METALLURGIST MANAGER** required for making special ferrous alloys. Must be familiar with ore-smelting calculations. Excellent prospects for man with organizing ability and capacity for work. Not over 40. Box No. 167, Institute of Metals, 4 Grosvenor Gardens, London, S.W.1.

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# METALLURGICAL ABSTRACTS

(GENERAL AND NON-FERROUS)

Volume 13

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Part 7

## I.—PROPERTIES OF METALS

**Beryllium—The Light Metal Steel.** Z. J. Atleo (*Modern Metals*, 1945, 1, (3), 7–8).—A general outline of the metal, its properties and alloys, is presented.—L. H.

**The Production of Beryllium Compounds, Metal, and Alloys.** Henry C. Kawecki (*Electrochem. Soc. Preprint No. 89-11*, 1946, 133–140).—The history and applications of beryllium are briefly reviewed. Recent developments in the processing of beryl and the present fluoride process for production of beryllium oxide are described. Electrolytic and electrothermal methods of reduction to produce beryllium or copper-beryllium alloy are described.

—A. B. W.

**The Production of Metallic Calcium by Thermal Reduction.** C. C. Loomis (*Electrochem. Soc. Preprint No. 89-9*, 1946, 119–126).—Details of a process for the production of calcium by the reduction of CaO with aluminium *in vacuo* at 1200° C., are given.—A. B. W.

**Cerium.** (Ahrens.) See p. 274.

**\*Internal Friction of Single Crystals of Brass, Copper, and Aluminium.** George H. Found (*Trans. Amer. Inst. Min. Met. Eng.*, 1945, 161, 120–138; discussion, 138–139).—See *Met. Abs.*, 1945, 12, 345.

**\*Determination of the Photoelectric Threshold of Copper.** André Blanc-Lapierre (*Compt. rend.*, 1942, 215, 321–323; *C. Abs.*, 1944, 38, 3193).—A quartz cell with a cathode of electrolytic copper, fused in a vacuum and thoroughly degassed and cleaned by heat and hydrogen treatment, has a threshold response at a wave-length of 2660 Å. This figure is in agreement with values obtained by Rentschler (*Rev. Sci. Instruments*, 1932, 3, 794) and by Schulze (*Z. Physik*, 1934, 92, 212) for pulverized copper and copper volatilized in a vacuum and also with values calculated from thermionic-emission data.

**Indium.** (Murray.) See p. 274.

**\*Hydrogen Content of Electrolytic Manganese and Its Removal.** E. V. Potter, E. T. Hayes, and H. C. Lukens (*Trans. Amer. Inst. Min. Met. Eng.*, 1945, 161, 373–381).—See *Met. Abs.*, 1945, 12, 346.

**\*Electrostriction in a Column of Mercury.** O. Yadoff (*Compt. rend.*, 1940, 211, 465–467; *Brit. Abs.*, 1945, [A I], 338).—When a vertical column of mercury is traversed by a heavy current, the density of the metal varies parabolically from the periphery to the axis. The c.d. varies in the opposite direction. An explanation is given.

**\*Effect of Longitudinal Magnetic Field on Torsional Oscillations of a Nickel Wire.** H. Billot (*Compt. rend.*, 1944, 218, 453–454; *Brit. Abs.*, 1945, [A I], 239).—The damping of torsional oscillations of a nickel wire in a longitudinal field of strength  $H$  varies with  $H$ . As  $H$  increases, the log. decrement ( $\delta$ ) first increases, passes through a maximum (at  $H \sim 80$  gauss), and then decreases. When  $H$  diminishes the original curve  $\delta = f(H)$  is not re-traversed. A non-ferromagnetic wire (copper) does not show these effects.

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

† Denotes a first-class critical review.



\*Investigation of the Thomson-Nernst Thermomagnetic Effect in Nickel Crystals. R. Annajev (*J. Physics (U.S.S.R.)*, 1945, 9, (4), 289-298).—[In English.] The Thomson-Nernst effect, i.e., the variation of thermoelectromotive force under the action of a magnetic field, was investigated for polycrystalline nickel specimens, and for single crystals of nickel. In the latter case, studies were made along the principal crystallographic axes and in the planes of the crystal. The apparatus is described and illustrated. The Thomson-Nernst effect depends markedly on the shape of the specimen, and thus upon the distribution of heat currents in the sample. The influence

of shape on the ratio  $\frac{\text{change of thermoelectric force}}{\text{initial thermoelectric force}}$  is less marked and can to a first approximation be neglected. Measurements were also made of the effect of internal elastic strains on the phenomena. The results, given graphically, are described and discussed in the light of the theory of ferromagnetism. —G. V. R.

\*The Experimental Proof of the Non-Supraconductivity of Grey Tin Down to 1.32° K. G. Sharvin (*J. Physics (U.S.S.R.)*, 1945, 9, (4), 350-351).—[In English.] By measurement of the magnetic moment of grey tin powder in a weak magnetic field at temperatures down to 1.32° K., it is shown that, above this temperature, no supraconductivity occurs. In stronger fields, a small magnetic moment is observed, due to the presence of a small amount of white tin, which may be demonstrated by X-ray experiments. It is concluded that grey tin is not a superconductor. —G. V. R.

The Theory of Hard-Drawn Materials, on the Basis of the Theory of Plasticity. Theodor Pöschl (*Arch. Eisenhüttenwesen*, 1943, 16, (10), 425-429; discussion, 1943, 17, (3/4), 99-100).—By the extension of a hardness formula, derived for elastic deformation, to the case of plastic deformation, the Brinell hardness in the plastic range is related to the quantity  $V$ , which represents the slope of the stress-strain curve.  $V$  is not a constant, but to a first approximation a mean value may be used. The Brinell hardness is proportional to  $Vd/D$ , where  $d$  and  $D$  are respectively the diameters of the impression and the indenting ball. Knowing the relation between the load and  $d/D$ , it is possible to derive by integration, from hardness measurements, the stress-strain curve for the material in compression. —G. V. R.

Problems in Non-Elastic Deformation of Metals. Clarence Zener and J. H. Hollomon (*J. Appl. Physics*, 1946, 17, (2), 69-82).—A general article assessing the potentialities of the various paths along which further research may profitably proceed. Anelastic phenomena are discussed, and the mechanism of plastic deformation by twinning and slipping is described in general terms. The possibility of a mechanical "equation of state" is dealt with in detail. Emphasis is laid throughout on unsolved problems and deficiencies in existing knowledge, and some specific recommendations for future research are made. —G. V. R.

Problems in Fracture of Metals. J. H. Hollomon and C. Zener (*J. Appl. Physics*, 1946, 17, (2), 82-90).—The phenomena associated with the fracture of metals are discussed in general terms, and features which are imperfectly understood are emphasized. The future research which might lead to a better understanding of fracture is reviewed, and specific recommendations are made, particularly with reference to the effects of various variables on fracture stresses, the hindrance of plastic deformation by sharp stress gradients, and the introduction of stress concentrations. —G. V. R.

Terminology in the Science of the Fatigue of Metals. Luigi Locati (*Met. Ital.*, 1942, 34, 237-241).—A review.

Viscous Flow of Crystalline Bodies Under the Action of Surface Tension. J. Frenkel (*J. Physics (U.S.S.R.)*, 1945, 9, (5), 385-391).—[In English.] It is suggested that the viscous flow usually attributed to amorphous bodies,

which occurs by the motion of a small number of holes or cavities, may also take place in crystalline substances. In the latter case flow would proceed by the diffusion under stress of vacant sites of the crystal lattice. This process is distinct from plastic deformation. The conception is developed mathematically, and applied to the rate of welding of crystalline powders, at temperatures below their melting points, into a crystalline body. The development of crystal faces on the surface of a spherically ground single crystal is also discussed from the same point of view, the common factor in each case being the reduction in surface energy caused by the change.—G. V. R.

**\*Oxidation by Friction Considered as a Chemo-Mechanical Process.** Kurt Dies (*Arch. Eisenhüttenwesen*, 1943, 16, (10), 399–407).—Using a special apparatus, the behaviour of various pairs of metallic materials when rubbed together under various loads, with and without lubrication, was examined. The materials included iron, hardened chromium steel, nitrided steel, austenitic chromium-nickel steel, tin, zinc, copper, aluminium, Elektron, Hydronalium, and a tungsten-cobalt-carbon sintered compact. The results of 17 experiments are tabulated and discussed, and the chemical analyses of the material removed are given. With lubrication, no frictional oxidation occurs, owing to the exclusion of oxygen. Without lubrication, the effects depend upon the materials which are paired together. The amount of wear is not always related to the hardness of the material, but depends on the hardness and adherence of the abrasion product. In the case of aluminium, the production of corundum was proved by X-ray and chemical methods; owing to the hardness of this oxide, most materials are badly abraded by aluminium. The bearing of the results on technical practice is discussed.—G. V. R.

**Graphical Methods for the Determination of Velocity of Solidification.** Miloslav Hampl and Václav Vodička (*Arch. Eisenhüttenwesen*, 1944, 17, (7/8), 185–191).—The mathematical equations governing the solidification of materials are developed, and new graphical methods are given for the solution of the fundamental equation  $\dot{d} = q\sqrt{T}$ , where  $d$  is the instantaneous depth (in m.) of the solidified layer and  $T$  is the time (in hr.). The method consists in finding  $q$  in terms of the physical constants, the freezing point, and the initial and final temperatures of the material involved. It is applied to the freezing of water and of steel. The solidification of steel in contact with cast-iron moulds and fireclay moulds is considered and discussed.—G. V. R.

**Melting Process in Non-Polar Crystals.** I. N. Stranski (*Naturwiss.*, 1942, 30, 425–433; *Brit. Chem. Abs.*, 1943, [A I], 55).—A lecture in which recent work is summarized and theories are discussed.

**Behaviour of Non-Polar Crystals Just Below the Melting Point and at the Melting Point.** I. N. Stranski (*Z. Physik*, 1942, 119, (1/2), 22–34; *Brit. Chem. Abs.*, 1943, [A I], 55).—Equilibria at the surfaces of non-polar crystals are discussed. It is supposed that the loosely bound structural units at the surface of a crystal undergo a change corresponding to melting at a temperature below the melting point. The appearance of new surfaces under these conditions is discussed. Small crystals must in general have a higher melting point than a large crystalline mass. The theory is compared with the results of experiments on certain metallic crystals.

**Preparation of Single Crystals.** Armando Durán (*Anal. Fis. Quím.*, 1941, 37, (Suppt.), 33–46; *Chem. Zentr.*, 1943, 114, (II), 6; *C. Abs.*, 1944, 38, 5123).—A review which includes: theory of crystallization, production of single crystals in molten masses, production by heating in the solid state, other methods, and determination of orientation. Bibliography.

**The Vapour Phases of Metals.** R. C. Vickery (*Metallurgia*, 1946, 34, (199), 4–7).—The thermodynamical basis of metal distillation is reviewed, together with aspects of the application of metal vaporization. The industrial applications, including large-scale zinc, aluminium, and magnesium distillation, and



recent technique for the formation of light filaments and metal coatings of silver, beryllium, and chromium by distillation, are collated, and distillation data are given for the more important physical properties of the commoner metals.—J. W. D.

**Active Substances.** LVIII.—Calculation of the Surface Energy of Non-Polar Solids from the Heat of Sublimation. R. Fricke (*Z. physikal. Chem.*, 1942, [B], 42, 284–294; *C. Abs.*, 1943, 37, 5308).—The temperature dependence of the total and free surface energy of metal surfaces can be calculated for the range in which the Dulong-Petit law is valid. Both the total energy and entropy are constant; the free energy decreases linearly with increasing temperature. Formulæ are given for many types of crystal lattice and numerical results are quoted for 12 metals.

**Surface Energy and the Heat of Sublimation of Solids.** R. Fricke (*Naturwiss.*, 1942, 30, 544–545; *Chem. Zentr.*, 1942, 113, (II), 2772; *C. Abs.*, 1944, 38, 3178).—Cf. abstract above. From the third law, the potential energy of surface formation in the Dulong and Petit region is represented by  $\sigma_T = \sigma_0 + A - BT$ ; the values of the constants  $A$  and  $B$  can be expressed on the basis of the concept of the crystal as a system of independent, harmonically vibrating Planck oscillators. The numerical values of  $\sigma_0$  and  $\sigma_{298}$  for the (100) and (111) faces of the face-centred lattices of aluminium, nickel, copper, silver, platinum, gold, and lead were calculated.

\*On the Diffusion of Inert Gases Through Metals. W. Lumpe and R. Seeliger (*Z. Physik*, 1943, 121, (9/10), 546–559).—Experiments on the initial distribution and diffusion of neon in a 0.3-mm. thick iron cathode of a glow discharge tube at temperatures up to 1100° C. for 15 hr. are described. Marked diffusion started at 100° C., while at any temperature the rate of gas evolution was at first rapid, then fell off and became asymptotic. Microscopic investigation of the cathode showed the distribution of the neon to be in a surface layer 0.002 to 0.005 mm. thick, containing a maximum of 45 c.c. of gas in 1 c.c. of metal.—E. N.

**On the Absorption of High-Frequency Sound in Metals.** L. Gurevich (*J. Physics (U.S.S.R.)*, 1945, 9, (5), 383–384).—[In English.] Theoretical. The absorption in metals of sound waves of such a short wave-length that the frequency exceeds the inverse time of the free path of the Debye waves, is investigated mathematically. Absorption takes place in a time of the order of the period of the sound, and such sounds cannot propagate in metals to any extent. According to the equations developed, the absorption coeff. is proportional to the frequency.—G. V. R.

\*The Closure and Partial Separation of a Metallic Contact. Alan Fairweather (*J. Inst. Elect. Eng.*, 1945, [I], 92, (56), 301–321).—F. has investigated the phenomena associated with nominally static contacts and those relevant to separating contacts up to the instant when the metallic path between the contacts ceases to exist. All the effects encountered in the change of resistance with current and mechanical pressure are shown to be predictable on the basis of the existence of contact spots. New light is thrown on the cause of the unequal wear of the two members of a contact pair, and it is suggested that alloys having a zero Thomson coeff. near their boiling point should be developed to overcome this trouble.—E. V. W.

**On the Measurement of the Depth of Generation of the Secondary Electrons in Metals.** A. Kadyshovich (*J. Physics (U.S.S.R.)*, 1945, 9, (5), 436–438).—[In English.] In order to determine the thickness of the emitter layer taking part in the creation of secondary electrons when metals are bombarded with electrons, it is usual to sputter thin layers of the metal under test on to the surface of another metal for which the secondary emission characteristics are known. Building-up of the layer is continued until the characteristics of the emission are identical with those of the massive metal which is being

deposited. The thickness of the layer is then taken as that of the emitting region for the particular metal. This method is discussed and criticized. It is pointed out that the deposition of a film alters the work-function of the original basis metal, so that its characteristics are no longer known. The method is therefore only justified for two metals with approximately equal work-functions, and with widely differing emission coeff.—G. V. R.

**Electrophysics of Solid Bodies. Iib.—Metallic Electron Conductors.** F. Möglichen and R. Rompe (*Physik regelmässig. Ber.*, 1942, 10, 1-19; *Chem. Zentr.*, 1943, 114, (I), 1451; *C. Abs.*, 1944, 38, 4165).—A report on publications between 1937 and 1941. The following topics are considered: general structure of metals, electrical and thermal conductivity, magnetic effects on conductivity and related phenomena, thin wires and films, supraconductivity, specific heat and thermoelectric phenomena. Investigations of metallic structure by X-rays are also dealt with.

**Magnetic Spectra of Diverse Materials at Various Frequencies.** V. Arkadiev (*J. Physics (U.S.S.R.)*, 1945, 9, (5), 373-378).—[In English.] A theoretical discussion of the dependence of the permeability of ferromagnetic materials exposed to the action of electromagnetic radiation on the frequency of the electromagnetic waves. A practical method for the elimination of the influence of eddy currents in experimental investigations is referred to, by means of which a true value of the complex permeability  $\mu - i\rho'$  may be evaluated. The quantity  $\rho'$  is connected with the circumstance that the magnetic induction  $B$  lags behind the alternating field  $H$ . The determination of magnetic spectra by investigations over a range of frequencies is discussed.—G. V. R.

**Theory of Ferromagnetic Hysteresis and Initial Permeability.** M. Kersten (*Physikal. Z.*, 1943, 44, 63-77; *Brit. Abs.*, 1945, [A I], 90).—The displacement of boundary layers between neighbouring spontaneously magnetized Weiss regions requires a certain min. field strength,  $H_0$ , the mean value of which agrees approx. with the coercivity  $H_c$ . The strain theory of coercive force gives a quantitative value for  $H_0$  if the variation of the surface strains ( $\gamma$ ) is taken into account. Initial permeability ( $\mu_0$ ) is given by the reversible displacement of the boundary layers. K.'s theory considers particles of impurities or local heterogeneities as energetically favoured points in the boundary layers, from which a definite coercive field is necessary to produce displacement of the boundaries. A quantitative interpretation of  $H_0$  and  $\mu_0$  is derived for magnetically hard and soft materials; and these magnitudes are expressed in terms of the crystallographic anisotropy of work of magnetization and the dimensions of the foreign particles. Concordant results are obtained for carbon steels.

**Fundamentals of the Supraconducting State.** J. Stark (*Physikal. Z.*, 1943, 44, 211-212; *Brit. Abs.*, 1945, [A I], 90).—The view that conductivity electrons, and, in general, electrons set free from their atomic ions, have a magnetic moment is supported by phenomena connected with supraconductivity. Conductivity electrons exert rotational and translational forces on each other on account of their magnetic moments. If they are not affected greatly by the magnetic fields of the opposite ions, and if the thermal perturbations are weak, the electrons will arrange themselves in more or less extended bands when an external magnetic field is applied. It is this condition which exists in supraconducting metals. The electrons do not now move singly, but as a band. The formation and destruction of the electron band is the process responsible for the magneto-caloric effect. The view that the electron has an annular structure is supported if the electron has a magnetic moment, the latter being regarded as the consequence of an inherent motion of its charge on a ring about its figure axis. The destruction of the electron band by a longitudinal magnetic field is also considered on the above theory.



**On the Surface Energy and the Behaviour of Supraconductors of Small Dimensions.** V. Ginsburg (*J. Physics (U.S.S.R.)*, 1945, 9, (4), 305-311).—[In English.] Theoretical. The depth of penetration of a magnetic field into a supraconductor is discussed, and the effect of the surface energy at the boundary between a supraconductor and a vacuum or a metal in the normal state is stressed. It is pointed out that bad agreement between the previous theories and the measured values of the critical fields for supraconducting films and massive specimens is due to neglect of the surface-energy factor. The relation between the critical field and the thickness of the film is developed taking this factor into account, and fair agreement with experiment is obtained.

—G. V. R.

**Some Observations on Supraconducting Hollow Bodies.** Karl Michael Koch (*Z. Physik*, 1941, 118, (1/2), 1-21; *Chem. Zentr.*, 1943, 114, (I), 252; *C. Abs.*, 1944, 38, 4847).—A homogeneous magnetization of the inner field strength is assumed for the walls of a supraconducting hollow sphere. For very small primary field strengths at the poles, there must be a breakdown of the supraconducting state. In the neighbourhood of the transition state, such a distribution of the micro-region is stable that only a narrow ring at the equator is completely supraconducting. Comparison of the results of Meissner and Heidenreich (*Z. ges. Kälte-Ind.*, 1934, 41, 125; *Met. Abs.*, 1935, 2, 211) on a supraconducting hollow cylinder, with the experiments of Shalnikov (*Nature*, 1938, 142, 74; *Met. Abs.*, 1938, 5, 527) on supraconducting hollow spheres, shows that the results can be explained by the distribution of micro-regions expected from the theory. From the effects present in a magnetic field (appearance of an induced continuous current in the equatorial zone and screening of the external field by surface current), it is concluded that the appearance of a macroscopic screening current arises from structural rearrangements that are determined by surface forces. Thus a new structural rather than electrical theory of supraconducting arises.

**An Attempted Electron-Physical Interpretation of the Meissner-Ochsenfeld Effect.** K. M. Koch (*Z. Physik*, 1940, 116, (9/10), 586-597; *Phys. Abs.*, 1944, 47, 57).—The transition from the normal conducting to the supraconducting state requires a temperature difference between the body under investigation and its environment, i.e., a heat flow from inside outwards. This heat flow, with the magnetic field constant, is shown to give an Ettingshausen-Nernst effect which, like the Corbino effect, produces a circular current. This current, with supraconduction present, changes to the screening current which nullifies the interior magnetic field.

## II.—PROPERTIES OF ALLOYS

**\*Evolution of Heat During the Precipitation in Aluminium-Copper Alloys at 225° C.** G. Borelius and Lennart Ström (*Arkiv Mat., Astron. Fysik*, 1945, [A], 32, (21), 10 pp.).—[In English.] The heat evolution corresponding to precipitation at 225° C. was measured as a function of time for alloys containing 2.0, 2.5, 3.2, and 4.5% of copper. This temperature is above the range in which Guinier-Preston aggregates are formed, and the dominating process is the precipitation of fine flat grains of the metastable  $\theta'$  phase with the composition  $\text{CuAl}_2$ . Curves of heat evolution (cal./g.-atom/hr.) against time are reproduced; they are initially linear, pass through a maximum, and then decrease approx. exponentially with time. The results are interpreted and discussed, and their bearing on the fluctuation theory for the production of precipitation nuclei is considered.—G. V. R.

**\*Effect of Assembly Ageing on the Properties of Several Aluminium and Magnesium Alloys.** G. R. Bailey and Max E. Tatman (*Aluminum and Magnesium*, 1945, 2, (1), 24-25, 29-30).—It may happen that assemblies



containing two or more heat-treatable alloys will be built up and then artificially aged. The ageing conditions for 24S aluminium alloy (super-Duralumin type) are 6½ hr. at 375° F. (190° C.), and those for 75S (which contains zinc and magnesium as principal hardening elements with smaller additions of copper and other elements) 24 hr. at 250° F. (121° C.). The principal alloys used in aircraft construction were heat-treated under these conditions both before and after ageing (for alloys which are normally aged) and as supplied (for alloys normally strain-hardened). It was found that in some cases the mechanical properties were affected, though not sufficiently to bring them below American specification minima, and that while the corrosion-resistance was sometimes reduced, the reduction was not sufficient to prevent satisfactory use.—E. C. E.

**Fatigue Strength of Aluminium and Magnesium Alloys.** H. F. Moore (*Aluminum and Magnesium*, 1945, 2, (2), 14–17, 28, 29).—An account in general terms addressed principally to designers, in which the main factors affecting fatigue strength are discussed.—E. C. E.

**The [Aluminium] Alloy FKG II and Its Manufacture.** András Domonyi (*Vegyí Ipar és Kereskedelem*, 1941, 3, (2), 3–4; *Chem. Zentr.*, 1943, 114, (I), 1928; *C. Abs.*, 1944, 38, 4551).—The alloy FKG II is easily workable, has a silvery lustre, and looks, when polished, like a metal with chromed surfaces. The strength of sand castings is 15–18 kg./sq. mm. and elongation 1.5–2.5%; when cast in metal moulds the corresponding figures are 18–20 kg./sq. mm. and 1.5–3%. Mylius No. = 7–8, density = 2.75, shrinkage = 3%. During melting, casting, and working it behaves like other aluminium alloys. The correct melting and casting temperatures are 730–750° C. and 710–720° C. respectively.

**Some Important Features of the Development of High-Strength Aluminium Alloys.** W. Bleicher (*Deut. Motor-Z.*, 1942, 19, 316–322; *Chem. Zentr.*, 1943, 114, (II), 566; *C. Abs.*, 1944, 38, 4894).—The tensile and corrosion-resisting properties are described for aluminium alloys of the aluminium-copper-magnesium type (DIN 1713), as well as for the same materials after cladding with pure aluminium, aluminium-magnesium-silicon alloy, or aluminium-manganese alloy. The three-layer cladding (with aluminium, aluminium-manganese, and aluminium layer) gives the most effective corrosion protection at present. The aluminium-zinc-magnesium alloys are more resistant to corrosion than aluminium-copper-magnesium alloy; likewise their stress-corrosion sensitivity can be removed by suitable refining measures and by correct alloying.

**\*The Supraconductivity of a Compound [Bi<sub>2</sub>Ni].** N. Alexeevsky (*J. Physics (U.S.S.R.)*, 1945, 9, (4), 350).—[In English.] Experiment indicates that the compound Bi<sub>2</sub>Ni, prepared by alloying bismuth and nickel in a H.F. furnace, annealing at 460° C., and quenching, shows supraconductivity. It is suggested that other compounds of bismuth with transitional elements behave similarly.—G. V. R.

**The Production of Beryllium Oxide and Beryllium-Copper.** Bengt R. F. Kjellgren (*Electrochem. Soc. Preprint No. 89-5*, 1946, 83–93).—The production of beryllium oxide from beryl is first described. The production of beryllium-copper in laboratory experiments and on an industrial scale in an arc furnace by reduction of beryllium oxide with carbon in presence of copper, is then dealt with.—A. B. W.

**The Production of Beryllium Compounds, Metal, and Alloys.** (Kawecki.) See p. 241.

**\*Phantom Laminations in Brass.** Daniel R. Hull, H. F. Silliman, and John R. Freeman, jun. (*Trans. Amer. Inst. Min. Met. Eng.*, 1945, 161, 203–212; discussion, 212–213).—See *Met. Abs.*, 1945, 12, 172.

\*The Alpha-Solid-Solution Field of the Copper-Manganese-Zinc System. R. S. Dean, J. R. Long, T. R. Graham, and A. H. Roberson (*Trans. Amer. Inst. Min. Met. Eng.*, 1945, 161, 232-243).—See *Met. Abs.*, 1945, 12, 352.

\*A White-High-Manganese Brass. R. S. Dean, J. R. Long, T. R. Graham, and C. W. Matthews (*Trans. Amer. Inst. Min. Met. Eng.*, 1945, 161, 244-252; also (abridged) *Metal Ind.*, 1945, 67, (13), 198-200).—See *Met. Abs.*, 1945, 12, 353.

\*The Constitution of the Gold-Germanium System. [Hardness of Gold-Germanium Alloys.] Robert I. Jaffee, Eugene M. Smith, and Bruce W. Gonser (*Trans. Amer. Inst. Min. Met. Eng.*, 1945, 161, 366-372).—See *Met. Abs.*, 1945, 12, 353.

Modern Wrought Magnesium Alloys. W. Ballantyne (*Modern Metals*, 1945, 1, (2), 24-25).—Tables showing specified min. properties of sheet, forgings, and extrusions of magnesium alloys are presented, and a bibliography of wrought magnesium alloys is given.—L. H.

\*The Solubility of Manganese in Liquid Magnesium. [Effect of Aluminium and Zinc.] N. Tiner (*Trans. Amer. Inst. Min. Met. Eng.*, 1945, 161, 351-357; discussion, 357-359).—See *Met. Abs.*, 1945, 12, 353.

\*Grain-Size and Properties of Sand-Cast Magnesium Alloys. R. S. Busk and C. W. Phillips (*Trans. Amer. Inst. Min. Met. Eng.*, 1945, 161, 266-276; discussion, 276-277).—See *Met. Abs.*, 1945, 12, 210.

\*Factors Affecting Abnormal Grain Growth in Magnesium Alloy Castings. A. T. Peters, R. S. Busk, and H. E. Elliott (*Trans. Amer. Inst. Min. Met. Eng.*, 1945, 161, 291-313; discussion, 313-314).—See *Met. Abs.*, 1945, 12, 354.

\*The Electrical Resistance of Iron Wires and Permalloy Strips at Radio Frequencies. Alva W. Smith, J. H. Gregory, and J. T. Lynn (*J. Appl. Physics*, 1946, 17, (1), 33-36).—The "skin effect" for iron and Permalloy specimens was investigated, and the ratios of the resistances using A.C. to those using D.C. were measured. The range of frequency studied extended from 1.5 to 6.0 megacycles/sec. Results are given in the form of empirical relations which are discussed in terms of existing theoretical equations derived on the assumption of constant permeability.—G. V. R.

\*The Hardness of Silver-Antimony Solid Solutions. R. M. Treco and J. H. Fryc, jun. (*Trans. Amer. Inst. Min. Met. Eng.*, 1945, 161, 360-365).—See *Met. Abs.*, 1945, 12, 45.

\*Thermodynamic Studies of Dilute Solutions in Molten Binary [Tin] Alloys. A. Yanko, A. E. Drake, and Frank Hovorka (*Electrochem. Soc. Preprint No. 89-13*, 1946, 151-164).—The systems tin-gold, tin-antimony, and tin-silver were studied in the dilute solution range on the tin-rich side over the temperature range 269-412° C., using a refined technique whereby measurements were made with a precision of  $\pm 0.01$  mV. The calculated activities of the more dilute solutions were in all cases ideal. Negative deviations of the activities of the solvent, increasing with the concentration of the solute, were obtained for the molten tin-gold and tin-antimony alloys. Positive deviations of the activities of the solvent, increasing with the concentration of the solute, were obtained for the tin-silver alloys. An increase in temperature caused a small but measurable decrease in the deviations of the activities from ideality for the molten tin-silver alloys, but not for the tin-gold and tin-antimony alloys.—A. B. W.

Remarks on the Strength of Cast Zinc Alloys. F. K. T. Beukema toe Water and H. C. J. de Decker (*Gas (Netherlands)*, 1943, 63, 34-38; *Chem. Zentr.*, 1943, 114, (II), 175; *C. Abs.*, 1944, 38, 5190).—In the practical use of cast zinc alloys, creep is of the greatest importance, within the stress range 2.5-3.5 kg./sq. mm. At greater stresses, e.g., with nuts on the bolts of gasometers, made from cast zinc alloys, fractures are frequently observed. Such nuts must not be tightened too much.



## III.—STRUCTURE

(Metallography; Macrography; Crystal Structure.)

[For all abstracts on the constitution of alloy systems, including X-ray studies, see II.—Properties of Alloys.]

\***A New Microscopy and Its Potentialities.** Charles S. Barrett (*Trans. Amer. Inst. Min. Met. Eng.*, 1945, 161, 15–64).—See *Met. Abs.*, 1945, 12, 212.

**A New Method for Producing Flat Metallographic Specimens.** P. M. Trismakov, F. A. Mikulchik, and Sh. L. Dobrushkin (*Zavod. Lab.*, 1941, 10, 323–324; *Chem. Zentr.*, 1942, 113, (II), 2737; *C. Abs.*, 1944, 38, 2910).—[In Russian.] The polishing disc consists of an iron or steel plate coated with a 50 : 50 lead–tin alloy having 60° grooves approx. 0.03 in. deep and 0.25 in. apart. Such an alloy or pure lead can be used in place of emery powder. As imbedding materials, a mixture of 40% wax + 60% rosin (for emery) or 40% paraffin + 60% rosin (for rouge or  $\text{Al}_2\text{O}_3$ ) is used.

**Quantitative Microscopic Analysis of Binary Alloys.** Salvatore Amari (*Ind. Meccan.*, 1943, 25, 99–105; *Chem. Zentr.*, 1943, 114, (II), 1143; *C. Abs.*, 1944, 38, 5469).—A good estimate of the composition of aluminium bronze or of steel can be obtained by metallographic study. With the former the relative contents of the  $\alpha$  and  $\beta$  phases can be estimated by microscopic study and with the latter the relative contents of ferrite and pearlite are determined.

**Applications of Metallic Shadow-Casting to Microscopy.** Robley C. Williams and Ralph W. G. Wyckoff (*J. Appl. Physics*, 1946, 17, (1), 23–33).—It is pointed out that, for micrographic work and especially for electron microscopy, the lower limit of visibility is often fixed by lack of contrast, and that contrast can be obtained by a metal shadow-casting technique. Thin films of metal are deposited obliquely on to the surface (specimen or replica) to be studied, and protuberances cast shadows, from the length of which heights may be estimated. The thickness of the metal film varies according to the inclination of surface irregularities to the metal source, and the variations in thickness are recorded on the photographic plate. The techniques, and the preparation of specimens, are discussed in detail, and the use of metal replicas is described. The paper is well illustrated with photographs showing the type of result obtained.—G. V. R.

\***Recrystallization of Aluminium in Terms of the Rate of Nucleation and the Rate of Growth.** W. A. Anderson and R. F. Mehl (*Trans. Amer. Inst. Min. Met. Eng.*, 1945, 161, 140–167; discussion, 167–172).—See *Met. Abs.*, 1945, 12, 213.

\***Textures, Anisotropy, and Earing Behaviour of Brass.** [Directional Variations of Mechanical Properties of Rolled Brass and Copper.] F. H. Wilson and R. M. Brick (*Trans. Amer. Inst. Min. Met. Eng.*, 1945, 161, 173–200; discussion, 200–202).—See *Met. Abs.*, 1945, 12, 357.

**On the Surface Motion of Particles in Crystals and the Natural Roughness of Crystalline Faces.** J. Frenkel (*J. Physics (U.S.S.R.)*, 1945, 9, (5), 392–398).—[In English.] Theoretical. It is pointed out that crystalline faces are not necessarily ideally plane with orientations corresponding to a small value of the surface energy. In reality vicinal faces, with only slightly higher surface energy, arise on them as a result of thermal fluctuations. The vicinal faces may be regarded as irregular terraces formed on the basis of the main faces, which are therefore not smooth but rough. The boundaries of the terraces are not fixed, but advance and retreat, and the process may be considered quantitatively as a type of Brownian movement. The mechanism of evaporation of atoms from the crystal, and the converse deposition, is discussed, in terms of the motion of atoms in the surface layer. It is concluded that adsorbed atoms from the two-dimensional adsorbed phase, on the surfaces of steps of the terraces, to the one-dimensional adsorbed line of atoms situated

at step edges, and pass thence into the gas phase. The bearing of the theory on heterogeneous catalysis is discussed.—G. V. R.

**\*The Orientation Texture at the Surface of Cast Metals.** Gerald Edmunds (*Trans. Amer. Inst. Min. Met. Eng.*, 1945, 161, 114; discussion, 115–119).—See *Met. Abs.*, 1945, 12, 176.

**\*Standards for Identifying Complex Twin Relationships in Cubic Crystals.** C. G. Dunn (*Trans. Amer. Inst. Min. Met. Eng.*, 1945, 161, 90–97).—See *Met. Abs.*, 1945, 12, 214.

**\*Orientation Changes During Recrystallization in Silicon Ferrite.** C. G. Dunn (*Trans. Amer. Inst. Min. Met. Eng.*, 1945, 161, 98–113).—See *Met. Abs.*, 1945, 12, 215.

**Calculation of Debye-Scherrer Diagrams of Very Small Crystals by the Gas-Interference Method.** H. Boersch (*Z. Physik*, 1942, 119, (3/4), 154–163; *Brit. Chem. Abs.*, 1943, [A I], 53).—The Debye-Ehrenfest interference function for a single rotating molecule is applied to the calculation of intensity distribution in the Debye-Scherrer diagram of crystalline particles containing 1, 2, and 8 unit cells for the cases of simple, body-centred, and face-centred cubic lattices. The method gives new maxima at low dispersion angles, which are not present in Bragg reflections from crystal planes.

**X-Ray Methods of Determining Size and Shape of Submicroscopic Crystals.** G. S. Zhdanov (*Zavod. Lab.*, 1940, 9, 732–740).—[In Russian.] A review.

**\*A Study of Age-Hardening [of Copper-Beryllium and Iron-Molybdenum Alloys] Using the Electron Microscope and Formvar Replicas.** D. Harker and M. J. Murphy (*Trans. Amer. Inst. Min. Met. Eng.*, 1945, 161, 75–89).—See *Met. Abs.*, 1945, 12, 356.

**\*Investigation of Secondary Phases in Alloys by Electron Diffraction and the Electron Microscope.** R. D. Heidenreich, L. Sturkey, and H. L. Woods (*J. Appl. Physics*, 1946, 17, (2), 127–136).—The application of electron diffraction and the electron microscope to metallurgical investigations on very small amounts of secondary phases and impurities in metals and alloys is described. It is pointed out that by the use of suitable etching techniques the secondary phase may be made to stand out from the surface sufficiently to give diffraction patterns, at grazing incidence, which contain no diffraction rings due to the matrix. Surface preparation is fully discussed, and electrolytic polishing is advised. Sources of error, such as redeposition of a component of the alloy on to the surface during etching, are described, and the potentialities of the method illustrated by brief references to work on magnesium, aluminium, and copper alloys, and on steel. Illustrative photographs and diffraction patterns are reproduced.—G. V. R.

**\*On the Improvement of Resolution in Electron-Diffraction Cameras.** James Hillier and R. F. Baker (*J. Appl. Physics*, 1946, 17, (1), 12–22).—The electron optics of the conventional electron-diffraction camera are described, special emphasis being laid on resolving power. It is shown that the resolving power depends on the size of the central spot caused by the focused electron beam in the plane of the diffraction pattern. A two-lens arrangement is described which decreases the size of the central spot and makes very high resolution possible. Further, by an alteration of the focal length of the second lens (the lens nearer the photographic plate) the arrangement may be converted into a shadow-type electron microscope. Intermediate arrangements are possible, in which the photograph records individual diffraction spots which are dark-field images of the diffracting particles, while the central spot is a bright-field shadow image of the same particles. The construction of a typical instrument is described, and common pitfalls in electron microscopy are fully discussed. Many excellent photographs are reproduced to show the potentialities of the method, and the high resolving power attainable.

—G. V. R.



## V.—POWDER METALLURGY

\*The Mechanism of the Pressing of Metal Powders. Hermann Unckel (*Arch. Eisenhüttenwesen*, 1945, 18, (7/8), 161–167).—The pressure distribution in the compact during the pressing operation in making sintered metal compacts was investigated in terms of the sp. gr. and the Brinell hardness of the resulting material, determined at various positions on the cross-section. The influence of friction at the walls of the mould cylinder, and the flow distribution in the powder during pressing were examined, and the effects discussed. From the results obtained, mainly on copper and iron powders, quantitative relations are derived.—G. V. R.

Symposium on Production and Design Limitations and Possibilities for Powder-Metallurgy Parts: Foreword. F. N. Rhines (*Trans. Amer. Inst. Min. Met. Eng.*, 1945, 161, 525–526); Design Factors for the Metal Forms with which Powder Metallurgy May Compete. Fred P. Peters (*ibid.*, 527–529; discussion, 530); Powder Metallurgy as Applied to Machine Parts. A. J. Langhammer (*ibid.*, 531–534; discussion, 534–535); Bearings from Metal Powders. W. R. Toeplitz (*ibid.*, 542–549; discussion, 549); Brushes and Allied Powder-Metal Parts. R. R. Hoffman (*ibid.*, 550–554); Electrical Contacts Manufactured from Metal Powders. E. I. Larsen (*ibid.*, 554–557); Friction Articles from Metal Powders. C. T. Cox (*ibid.*, 565–567; discussion, 567–568); \*Certain Characteristics of Silver-Base Powder-Metallurgical Products. F. R. Hensel and E. I. Larsen (*ibid.*, 569–579; discussion, 579); \*Some Properties of Sintered and Hot-Pressed Copper-Tin Powder Compacts. Claus G. Goetzl (*ibid.*, 580–593; discussion, 593–595); \*The Sintering of Metal Powders—Copper. C. J. Bier and J. F. O'Keefe (*ibid.*, 596–611); \*Some Experiments on the Effect of Pressure on Metal-Powder Compacts. Jerome F. Kuznick (*ibid.*, 612–630; discussion, 630–632); General Discussion (*ibid.*, 632–634).—See *Met. Abs.*, 1945, 12, 48, 177–179.

## VI.—CORROSION AND RELATED PHENOMENA

\*Study of the Oxidation of Aluminium by Air at the Ordinary Temperature by Measuring the Potential of Solution. Pierre Morrice and Paul Lacombe (*Compt. rend.*, 1946, 222, (12), 658–659).—It has been shown (L. and Chaudron, *Rev. Mét.*, 1936, 33, 697; *Met. Abs.*, 1937, 4, 390) that ordinary mechanical polishing of aluminium cannot produce a surface entirely free from oxide; in fact, the abrasion of polishing raises the surface temperature sufficiently to increase the rate of oxidation. An entirely oxide-free surface on very pure (99.99%) aluminium was obtained by electrolytic polishing in a bath of 2 : 1 acetic anhydride and perchloric acid ( $d = 1.61$ ), avoiding all contact of the metal with air or water. After polishing, the metal was plunged into pure acetone to remove the viscous polishing film, and then washed in alcohol. The entire absence of an oxide film was demonstrated by measuring the potential of electrolytic dissolution, which is more sensitive than electronic diffraction (see Koch and Lehmann, *Aluminium*, 1941, 23, 304). It was observed during these experiments that the humidity of the air played an essential part in the reaction of aluminium to air at ordinary temperatures; the presence of water appreciably increases the rate of the reaction. This fact explains why only the polishing bath described above will give oxide-free surfaces, since phosphate and fluoroborate baths contain a considerable proportion of water.—J. H. W.

\*Corrosion-Resistance of Heat-Treated 24S Aluminium Alloy. Charles Nagler (*Aluminum and Magnesium*, 1945, 2, (1), 26–29).—An investigation

into the effect of the interval between removal from the salt bath after solution-treatment and immersion in the quenching bath on the susceptibility to intercrystalline corrosion in 24S alloy (4.6% copper, 0.6% manganese, 1.5% magnesium, balance aluminium). The samples were subjected to a corrosion test in NaCl/H<sub>2</sub>O<sub>2</sub> solution, and under the conditions of the experiments intercrystalline corrosion was observed when the time interval was 15 sec. or longer. The susceptibility to corrosion was not revealed in tensile tests on the material before the corrosion test.—E. C. E.

**Corrosion of Light Metals and Its Prevention.** András Domony (*Bányász. Kohász. Lapok*, 1943, 76, 221-230; *Chem. Zentr.*, 1943, 114, (II), 1846; *C. Abs.*, 1944, 38, 6266).—Various types of corrosion (chemical, electrochemical, and intercrystalline) occurring in light alloys, and the effect of alloying elements, impurities, and heat-treatment, are discussed. Protective methods are described in detail, and operating suggestions are given for anodic oxidation, chemical oxidation, plating, galvanizing, and lacquering.

**\*Corrosion Studies on Electrolytic Chromium.** Norman Hackerman and Donald I. Marshall (*Electrochem. Soc. Preprint No. 89-15*, 1946, 171-180).—The corrosion of electrolytic chromium stripped from the basis metal has been studied in both active and passive states in solutions of NaOH, HCl, H<sub>2</sub>SO<sub>4</sub>, CH<sub>3</sub>COOH, and NaCl at various concentrations, and in the last case over a pH range of 0-11. Passive metal showed only isolated instances of attack, while in the active state attack occurred in all media with pH lower than 3. At higher pH the metal usually became passive after a short time, even in de-aerated solutions. Short exposures in acid media resulted in attack along the crack network system. Attack at isolated points in alkaline NaCl solutions was not related to the crack system.—A. B. W.

**\*Corrosion of Yellow Brass Pipes in Domestic Hot-Water Systems—a Metallographic Study.** E. P. Polushkin and Henry L. Shuldener (*Trans. Amer. Inst. Min. Met. Eng.*, 1945, 161, 214-230; discussion, 230-231).—See *Met. Abs.*, 1945, 12, 49.

**Corrosion Damage in Surface Condensers.** F. Börsig (*Maschinenschaden*, 1943, 20, 5-16; *Chem. Zentr.*, 1943, 114, (I), 2731; *C. Abs.*, 1944, 38, 4898). The types and causes of corrosion are reviewed. Water causes more damage than steam. Brass is very liable to corrode, though the addition of as little as 0.02% of arsenic protects it.

**Fatigue Cracking of Coated Lead Alloys.** Lawrence Ferguson (*Bell Lab. Record*, 1946, 24, (2), 53-56).—A description is given of an investigation carried out to determine the effect of a coating of polyisobutylene on the fatigue strength of U.S. chemical lead and antimonial lead alloys. The coating is helpful at high rates, but harmful at slow rates of stress reversal. It is also protective with small stresses, but harmful at large ones.—E. V. W.

**Field-Laboratory Tests of Alloy Cable Sheath.** F. B. Livingston (*Bell Lab. Record*, 1944, 22, (10), 441-444).—L. describes field trials carried out on aerial cables with some of the failures experienced.—E. V. W.

**\*Experimental Study of Some Corrosion Phenomena of Zinc.** E. Lagrange (*Métaux, Corrosion-Usure*, 1942, 17, 164-167; *Chem. Zentr.*, 1943, 114, (I), 1755; *C. Abs.*, 1944, 38, 3946).—Metallic zinc was attacked by immersing the two ends of a curved strip in oxygen-containing aqueous solutions, which also contained 2% of gelatin to increase viscosity, 1% of NaCl, a trace of acetic acid, and a few drops of phenol red. Of the two alkaline regions which formed round each immersed end at the beginning of the experiment, one grew continuously, and the other decreased and finally disappeared. The formation of the asymmetry was promoted by the reduced ion mobility in the viscous solution. L. explains the phenomenon by assuming inhomogeneity in the zinc. Iron and aluminium show similar effects.



\*The Time-Temperature Relation for the Solution of Zinc in Dilute  $\text{H}_2\text{SO}_4$ . Gustav Nilsson (*Tekn. Tidskr.*, 1942, 72, (37), 65–68; *Chem. Zentr.*, 1943, 114, (I), 498; *C. Abs.*, 1944, 38, 2871).—The speed of solution of zinc in  $\text{H}_2\text{SO}_4$  was determined by the quantity of hydrogen developed. It varies with temperature and concentration and again with the final quantity of zinc dissolved. The speed increases rapidly between 20° and 40° C., increases more slowly between 40° and 50° C., then decreases, very pronouncedly, to about 60° C., and is the same at 70° C. as it was at 20° C. Reasons for the decrease in speed are structural changes, impurities on the cathodes, protective films formed on the metal, and more uneven attack by the acid. Addition of  $\text{ZnSO}_4$  has a greater retarding effect at 70° C. than at 20° C.

Intercrystalline Corrosion and Its Dangers. L. Tronstad (5 *Nord. Kemi-kermæde*, 1939, 74–95).—A review.

## VII.—PROTECTION

(Other than by Electrodeposition.)

Recent Studies of the Anodic Oxidation of Aluminium and Its Alloys. J. Hérenghuel (*Chim. et Ind.*, 1945, 54, (6), 389–395).—A summary of the results of recent French work on anodic oxidation. See *Met. Abs.*, this vol., pp. 52–53.—E. C. E.

Sulphamic Acid in Electrochemical Processes, Including Anodic Oxidation. (—). See p. 256.

\*Studies of the Chemical Properties and Structure of Anodic Deposits and Coatings. IV.—Polar-Optical Analysis of the Disperse Structure of Oxide Coatings on Aluminium. K. Huber (*Helv. Chim. Acta*, 1945, 28, (7), 1416–1420).—[In German.] Anodic deposits of oxide show marked double refraction if precipitated from an oxalic acid bath; deposits of this type on aluminium sheet were isolated, usually by Treadwell's method, and examined by polarized light. The refractive qualities of the deposit depend on the orientation of the crystallites in the basis metal. The double refraction observed is uniaxial when a cube face is parallel with the surface of the metal, and biaxial when the quaternary axes are oblique with respect to the metal surface. A tabular summary contrasts the behaviour of aluminium with that of zinc under similar conditions.—P. R.

Detection and Removal of Protective Coatings on Aluminium. H. Couturier (*Lait*, 1943, 23, 15–17; *Chem. Zentr.*, 1943, 114, (II), 191; *C. Abs.*, 1944, 38, 5484).—The aluminium sheet is immersed, coated surface downwards, in a 1%  $\text{HgCl}_2$  solution in a developing tray which is gently rocked. The metal turns grey in 1–2 min. It is rinsed with water and placed in a 1%  $\text{H}_3\text{PO}_4$  or  $\text{HgCl}_2$  solution. All the aluminium dissolves in about 10 min.; the coating remains and can be examined. If the aluminium is coated on both sides, the coating on one side must first be removed by rubbing it off with a solvent. The protective coating can be detected simply by means of a 5%  $\text{HCl}$  solution. With uncoated aluminium the solution develops considerable heat in 1 min., but if it is thickly coated there is no reaction.

The Alplate Process. Colin G. Fink (*Aluminum and Magnesium*, 1945, 2, (2) 26–27).—F. describes a process for coating steel with aluminium. The principal steps are as follows: The steel strip or wire is surface-cleaned in alkali and acid, then dried and fed into a hydrogen furnace, and from there directly into the molten aluminium bath. It goes next through a wiper and on to a receiving drum or reel. The steel absorbs hydrogen in the furnace. The hydrogen is liberated in the nascent state in the aluminium bath and reduces the alumina formed, thus ensuring perfect union between the aluminium

and iron. The coated strip or wire is free from pinholes and may be rolled, drawn, or anodized.—E. C. E.

**Clad Light Metals.** H. Kalpers (*Wien. Chem.-Zeit.*, 1943, 46, 81-84; *Chem. Zentr.*, 1943, 114, (II), 1751; *C. Abs.*, 1944, 38, 5784).—Duralplat (copper-free Duralumin on copper-containing Duralumin in a layer of thickness 5.0-7.5% that of the basis metal) has greater resistance to sea-water and atmospheric corrosion than has Duralumin. The mechanical properties are identical, but frequent or long-continued annealing should be avoided, because of the danger of diffusion of copper to the surface. Albondur and Bondurplat (pure aluminium and aluminium alloy, respectively, on the aluminium-copper-magnesium alloy Bondur, in layers of 5% thickness) have a high resistance to corrosion. The mechanical properties of the first are somewhat inferior to those of Bondur. Bondurdiff (Albondur 1% layer) is similar in mechanical properties to Bondur. Cupal (electrodeposited copper on aluminium) in layers of 10-30 or 5-15% is utilized for sheet, tubing, and wire. It can be plated with other metals.

**Laminated Aluminium Solves Protection Problems.** John M. Cowan (*Modern Metals*, 1945, 1, (7), 13).—L. H.

**Saving Chromium by Chromizing.** H. Kalpers (*Oesterr. Chem.-Zeit.*, 1942, 45, 109-111; *C. Abs.*, 1944, 38, 4897).—In the BDS (Becker, Daeves, and Steinberg) process a superficial layer of chromium is formed upon steel by leading HCl and hydrogen in gaseous form over ferrochrome and then the  $\text{CrCl}_2$  so produced acts upon the metal to be chromized, replacing iron by chromium; a kind of cementation takes place, but of molecular dimensions, and by proper heating and rolling or other treatment the layer of chromium can be made of the desired thickness. Results are much better than in chromium plating, with its intermediate layers of copper, nickel, &c. Zones with 13% or less chromium are attacked or corroded, but those with more than 13% chromium are very resistant to corrosion. The composition of the steel treated is important. Chromizing cannot replace ordinary rustless (alloy) steels in all cases, but can take their place, with great saving of chromium, in many instances.

**On Homogeneous Lead Coating.** A. Kufferath (*Schleif- u. Poliertechn.*, 1943, 20, 54-55; *Chem. Zentr.*, 1943, 114, (II), 1132; *C. Abs.*, 1944, 38, 5191).—Homogeneous lead coating is preferred to coating by rolling. The preliminary treatment of the surface to be coated, the use of lead alloys, and different chemical methods which improve the coating, are discussed.

**Anodic Process for Protecting Magnesium.** N. H. Simpson and Paul Cutter (*Modern Metals*, 1945, 1, (2), 18-21).—An anodic process is described which produces a finish on magnesium alloys by using either A.C. or D.C., which is claimed to be superior in corrosion- and abrasion-resistance to the finishes produced by the acid dichromate and chrome pickle treatments. After degreasing, the magnesium parts are placed in the alkaline bath as cathode for electro-cleaning with D.C. If D.C. is employed in producing the finished coating, the current is reversed and the work is made the anode. If A.C. is used for the finish, the magnesium parts are connected to a low-voltage A.C. transformer after electro-cleaning. The corrosion-resistance of the finish coating so produced is somewhat enhanced by certain inorganic additions to the bath, high temperatures, and A.C. The anodic coating is an excellent dielectric and accordingly acts as an insulator in inhibiting galvanic corrosion when magnesium parts so protected are brought in contact with dissimilar metals.—L. H.

**Processing [Protection] of Magnesium Alloys.** N. H. Simpson (*Aluminum and Magnesium*, 1945, 2, (3), 18-22, 36-38).—An account of conditions which cause corrosion of magnesium alloys, and ways of preventing corrosion.

—E. C. E.



**A Protective Finish for Magnesium Alloys.** R. B. Mason (*Iron Age*, 1946, 157, (12), 48–52).—A method is described of producing relatively heavy protective coatings on magnesium alloys by anodic oxidation in a caustic soda electrolyte, followed by sealing in a chromate solution. This finish provides a heavy oxide coating with high abrasion- and corrosion-resistance.—J. H. W.

**Electrolytic Oxidation of Magnesium and Magnesium Alloys.** W. Hanswaid (*Z. Metall- u. Schmuckwaren-Fabrik. Verchrom.*, 1943, 24, 99–101).—A review of the patent literature.

**Magnesium for Cathodic Protection.** Arthur Smith, jun. (*Modern Metals*, 1945, 1, (9), 22–23).—S. describes how the corrosion of underground installations occurs, and shows how the use of magnesium anodes may result in large savings in gas, water, and oil pipe-lines and cables by protecting them galvanically. The manufacture of the anodes and the method of locating them to prevent corrosion, are described.—L. H.

**Surface Protection and Chemical Colouring of Zinc and Zinc Alloys.** H. Krause (*Z. Metall- u. Schmuckwaren-Fabrik. Verchrom.*, 1943, 24, 15–16; *Chem. Zentr.*, 1943, 114, (I), 1931; *C. Abs.*, 1944, 38, 4239).—Recipes for colouring zinc, and data for protection by phosphatizing and chromatizing, are given.

**Lockheed Requirements for Protective Coatings.** Maxwell Stiles (*Indust. Finishing*, 1944, 20, (5), 18, 22, 24, 28, 30, 32, 38).—Accounts are given of the following cleaning and painting processes in the production of aircraft parts: application of zinc chromate priming coat of controlled thickness; treatment of joints and seams; prevention of contact between dissimilar metals; treatment of threaded or bearing surfaces; surface treatment of aluminium and its alloys; anodic oxidation; chemical treatment of magnesium; protection of cables and fittings; treatment of junction boxes; protection of ornamental work, plastics, and woods.—P. R.

**Protection Against Corrosion of Apparatus for the Chemical Industry.** P. Bourgois (*Chim. peintures*, 1943, 6, 171–177; *Chem. Zentr.*, 1943, 114, (II), 1035; *C. Abs.*, 1945, 39, 52).—A review of conditions promoting corrosion (nature of the aggressive agent, operating temperature, &c.), and the physical and chemical properties of materials used for such equipment, including metals and metal alloys and such mineral products as acid-resistant brick and tile, concrete, cement, acid-resistant cements, glass, quartz, and hydrocarbons.

**The Theory and Use of Zinc Chromate Primers.** Paul O. Blackmore (*Indust. Finishing*, 1944, 20, (7), 24–35; (8), 38–48, 52, 54, 59).—The functions of the priming coat are briefly reviewed. The compositions of primers containing zinc chromate are tabulated, with information regarding the nature of the vehicle, weight per gallon, viscosity, and colour. The main factors in the protective action of zinc chromate are considered, as are the functions and optimum proportions of such additions as asbestine. The nature and causes of adhesion between paint and metal are reviewed in some detail, and recommendations are made with regard to the testing of viscosity and specific gravity.—P. R.

## VIII.—ELECTRODEPOSITION

**Copper Plating on Aluminium.** Marcel Ballay (*Métaux, Corrosion-Usure*, 1942, 17, 133–138; *Chem. Zentr.*, 1943, 114, (I), 88; *C. Abs.*, 1944, 38, 2882).—The aluminium is dipped in  $\text{Fe}(\text{ClO}_4)_2$  solution (100 litres water, 6 litres  $\text{Fe}(\text{ClO}_4)_2$  solution of 45° Bé., and 3 litres of  $\text{HCl}$  (d 1.19)); then a flash of nickel is given and afterwards one of copper. The method is applicable to pure aluminium and to Alpac (13% of silicon).

**Brass Plating: Automatic Plant for Treating Steel Components.** Alan Smart (*Elect. Rev.*, 1944, 135, (3501), 911–913; *Elect. Eng. Abs.*, 1945, 48, 88).—Describes an automatic plant carrying out the following brass-plating

schedule: alkaline electro-cleaning, rinsing, anodic  $\text{H}_2\text{SO}_4$  etching, rinsing, immersing in cyanide solution, plating, rinsing, passivating, rinsing, and drying. The plating solution used contains: zinc 30, copper 15, sodium carbonate 20 g./litre; and pH 12.6-12.8. Mechanical details of the equipment for transferring the components from tank to tank are briefly described. Oil-immersed selenium rectifiers supply currents up to 4000 amp. at 8 V. for the various baths.

**\*Rapid Determination of Copper and Zinc in Cyanide Brass Baths.** F. I. Verdin (*Zavod. Lab.*, 1941, 10, 648; *Chem. Zentr.*, 1943, 114, (I), 1303; *C. Abs.*, 1944, 38, 3213).—[In Russian.] The procedure described calls for the deposition of Cu and Zn by electrolysis of the solution as it is to begin with and after periodic additions of NaOH. The two metals are weighed together, the deposit is dissolved in acid, and the Cu alone then determined by electrolysis.

**\*The Protective Value of Lead and Lead-Tin [Electro]Deposits on Steel.** A. H. Du Rose (*Electrochem. Soc. Preprint No.* 89-7, 1946, 101-112).—The protective value of deposits from fluoborate baths has been evaluated by outdoor exposure and salt-spray tests. The results were surprisingly good. In the case of the lead deposits the covering power and protection were improved by glue additions to the bath. Lead-tin alloy deposits containing 5-6% of tin were superior to pure lead and also to alloy deposits containing more tin. This is possibly related to the limit of solid solubility of tin in lead.—A. B. W.

**Newer Methods for the Preparation of Bright Zinc Coatings.** Kurt Nischk (*Schleif-, Polier- u. Oberflächentechn.*, 1943, 20, 81-82; *Chem. Zentr.*, 1943, 114, (II), 2204; *C. Abs.*, 1944, 38, 5784).—Review of German patents, with data on bath compositions, for the production of bright zinc coatings.

**†Plating Die-Castings.** [I.—] Preliminary Processes Before Plating. [II.—] Methods of Adding Nickel Cover. [III.—] Control and Purification of the Nickel Solution. [IV.—] The Application of the Final Chromium Plate. E. A. Ollard and E. B. Smith (*Metal Ind.*, 1946, 68, (13), 246-248; (15), 286-288; (17), 325-328; (19), 366-368).—In direct plating zinc-base die-castings containing 3-4% of aluminium and small quantities of other metals, special precautions are required to overcome the difficulties encountered owing to the solubility of the alloy in the plating solution and to the ease with which the hard thin skin of the alloy can be removed by cleaning. Hence, over-polishing and over-cleaning are to be avoided; the time of the degreasing operation is especially important in automatic working. These die-castings can be plated in an ordinary copper cyanide bath in which the free cyanide is kept as low as possible. The methods are detailed for the production of a dull nickel deposit for polishing and chromium plating using a Watts type of bath, and a bright deposit for chromium plating without intermediate polishing using the Weisberg and Stoddard and the Hinrichsen processes. Cobalt is required in the bath and is added as the sulphate. The control of the solution and the detection, estimation, and removal of impurities, such as iron, copper, and organic matter, are described. Full details of chromium plating the castings and the control of the bath are given, and the application of silver, speculum, and bronze finishes is described.—J. H. W.

**Sulphamic Acid in Electrochemical Processes, Including Anodic Oxidation.** — (*Metallurgia*, 1946, 34, (199), 7-8).—A brief *résumé* of some of the work carried out with sulphamic acid in electrochemical processes, including anodic oxidation, is given. Results of work on the electrodeposition of Rh, Cu, Fe, Ni, Co, Ni-Co alloy, Pb, Ag, Zn, Cd, Mg, and Th using a sulphamic acid electrolyte are tabulated. In the case of the last five metals no particular advantage is gained with sulphamic acid over sulphuric acid,



except possibly in the case of cadmium, using glue and nickel sulphate as addition agents.—J. W. D.

**Electroplating and the Motor Industry.** H. Silman (*J. Electrodepositors' Tech. Soc.*, 1946, 21, 65-78).—Specifications and practice in the electroplating of automobile components are reviewed, possibilities of improvement are noted, and future prospects of the industry are considered.—A. B. W.

**Electroplating Facilities at Murray Hill.** R. A. Ehrhardt (*Bell Lab. Record*, 1944, 22, (16), 609-613).—A description is given of the Bell Laboratories experimental electrodeposition plant.—E. V. W.

**Soft Mipolam 1014, a Valuable Lining for Plating Tanks, Especially Those for Hard Chromium.** Hans A. Sagel (*Metallwaren-Ind. u. Galvano-Techn.*, 1943, 41, 60-61; *Chem. Zentr.*, 1943, 114, (II), 476; *C. Abs.*, 1944, 38, 5459).—Soft Mipolam 1014 (vinyl polymer) in the form of ribbon, tubing, and sheet is used in the plating industry as a stop-off for racking frames, and for shielding metal parts not required to be plated. It resists most electroplating baths, especially chromium baths up to 60-70° C.; it possesses high flexibility, stability on ageing, and can easily be removed after use. The exact composition of Mipolam is not disclosed.

## IX.—ELECTROMETALLURGY AND ELECTROCHEMISTRY

(Other than Electrodeposition.)

**\*The Anodic Passivation of Copper in Dilute Sodium Hydroxide.** W. Feitknecht and H. W. Lenel (*Helv. Chim. Acta*, 1944, 27, (3), 775-789).—[In German.] The voltages and current densities at which copper becomes passive in dilute sodium hydroxide have been determined and the metallic or oxidized surface resulting in each case has been examined microscopically and by X-rays. The electrolyte must be stirred, as otherwise action takes place mainly at the anode, which rapidly becomes coated with cupric hydroxide and ceases to function; this occurs most quickly at high current densities and at low concentrations of sodium hydroxide. The relationship between current density and rate of passivation follows the "law of surface coating" stated by W. J. Müller. Stirring of the electrolyte causes the deposition on the electrode of cuprous oxide; this is quickly transformed to cupric oxide, whilst if stirring ceases a coating of hydroxide forms over the oxide. The potentials corresponding with possible reactions between electrode and electrolyte are tabulated for normal sodium hydroxide solution. It is stated that the rapidity of these reactions depends on the orientation of the crystallites at the surface.—P. R.

**\*On the Electrolytic Preparation of Tungsten-Iron Alloys.** Jean-Lucien Andrieux and Georges Weiss (*Compt. rend.*, 1946, 222, (12), 646-647).—Alloys of iron and tungsten were prepared from the secondary reactions occurring in the electrolysis of the two oxides dissolved in a bath of molten borax. Two compounds were so prepared,  $\text{Fe}_3\text{W}_2$  containing 68.72% of tungsten, and  $\text{Fe}_2\text{W}$  containing 62.23%. They have very similar chemical properties and both form beautiful clusters of grey metallic crystallites. They resist the action of hydrochloric acid, but are easily decomposed by *aqua regia* and nitric and sulphuric acids, with the precipitation of tungstic acid. Sodium peroxide and molten alkaline reagents attack them rapidly.

—J. H. W.

**\*Electrolysis of Manganese into a Metal Cathode from Suspensions of Manganese Oxide and Carbon in Molten Manganous Chloride.** Burke Cartwright and S. F. Ravitz (*Electrochem. Soc. Preprint No. 89-4*, 1946, 73-81).—Manganese was electrodeposited at 700° C. into a molten tin cathode from manganous chloride melts and from suspensions of manganese oxide and carbon in fused

manganese chloride, with a current efficiency of 88% in the former case and 57-75% in the latter. Practically all the chlorine was utilized in regeneration of manganous chloride. The possibilities of using this method for the production of pure manganese or usable manganese alloys are discussed, and zinc rather than tin is suggested as probably the most suitable cathode metal for either purpose.—A. B. W.

\*On the Electrolytic Reduction of Aqueous Solutions of Chromic Acid.—II. Erich Müller (*Z. Elektrochem.*, 1943, 49, (1), 16-37).—Continues the discussion of the electrolytic reduction of chromic acid solutions (see *ibid.*, 1940, 46, 82; *Met. Abs.*, 1940, 7, 215). A description is given of the polarization phenomena occurring when solutions of pure and 30% chromic acid, sulphate-free and sulphate-containing, are electrolysed with cathodes of gold, silver, iridium, chromium, and copper. Graphs are given of cathode potential plotted against current density, for each type of cathode. Müller's theory of ionic-film formation is further developed and is shown to explain all the phenomena observed.—E. N.

\*The Change of Overvoltage with Temperature. György v. Sigmund (*Magyar Chem. Folyóirat*, 1941, 47, 173-192; *Chem. Zentr.*, 1943, 114, (I), 373; *C. Abs.*, 1944, 38, 2883).—Hydrogen overvoltage is determined on cathodes of pure mercury, platinum, rhodium, and palladium, the electrolyte being 2*N*-HCl or H<sub>2</sub>SO<sub>4</sub> solutions. The absolute values decrease as the temperature is increased. On the mercury cathode the Tafel equation holds from 0 to 80° C. Constant *a* decreases with temperature according to the equation  $a = A/Te^{mT}$ . Constant *b* increases with temperature in accordance with the theory of Erdey-Grúz and Volmer. On platinum the Tafel equation holds only for saturation with hydrogen; constant *a* decreases with temperature, constant *b* increases from 0° to 10° C., then decreases. On rhodium or palladium the Tafel equation does not hold.

\*New Action of Magnetism. G. Destriau (*Compt. rend.*, 1940, 211, 380-382; *Brit. Abs.*, 1945, [A I], 338).—It is shown that when a nickel electrode is placed in a solution of NiSO<sub>4</sub> and is then submitted to the action of a magnetic field, an e.m.f. arises, which is distinct from the magnetization e.m.f. The experiment is repeated with non-ferromagnetic electrodes so that no magnetization e.m.f. can interfere. The system copper-CuSO<sub>4</sub>-copper is studied. The copper electrodes are placed in the two limbs of a U-tube, and the magnetic field is applied to one of them. The electrode in this limb develops a very small negative e.m.f. for the first hour, and then a strong positive potential tending towards a limit, *E*<sub>1</sub>. The initial negative potential being neglected, the potential *E* after time *t* is given by  $E = E_1 e^{\theta/t}$ , where  $\theta$  is a constant. The potential does not depend on the orientation of the electrode. Fields of 3000-10,000 gauss are used, and there is no saturation effect within these limits. *E*<sub>1</sub> is independent of the concentration of the electrolyte. If the solution around the electrode is replaced by a fresh solution, the potential falls at once to zero, but the "activated" electrode slowly acts on the new solution, and in 15-20 min. the e.m.f. resumes the value which corresponds to the applied field. The electrode only slowly becomes deactivated and the solution can be replaced several times with similar results. A similar effect is obtained if the solution is in the magnetic field but the electrodes are not.

## XI.—ANALYSIS

Spectrochemical Analysis for the Examination of Metals. R. Schmidt (*Polytechn. Weekblad*, 1943, 37, 257-261).—A review.

Introduction of Rapid Spectral-Analytical Methods for the Testing of Metals. Rudolf Holzhauser (*Anz. Maschinenwesen*, 1944, 66, (2), Suppt., 5-7).—A review.



\*Effect of "Fixed Burning" of a Spark Discharge on the Analytical Results, Investigated on the System Zinc-Copper-Aluminium-Magnesium. A. Schöntag (*Z. wiss. Phot.*, 1942, 41, 237-250; *C. Abs.*, 1944, 38, 5745).—In the resonance spark generator, the spark at first wanders from point to point on the electrode; after a time the character of the discharge changes, so that the spark remains for a considerable time at the same point on the electrode; this latter form of discharge is called "fixed burning." The two forms are discussed in relation to conditions of the discharge, and the possible effect of the transition from one discharge form into the other on the analytical error is quantitatively investigated in respect of Zn-Cu-Al-Mg alloys.

\*The Use and Performance of Colorimetric Methods. A. Schleicher (*Z. anal. Chem.*, 1943, 125, (11/12), 385-405).—S. discusses the usefulness, performance, and sensitivity characteristics of colorimetric analysis with special reference to the determination of Cu. Using a Lange photoelectric colorimeter, results are given for the following methods: ammonia, sulphide, benzidine, ferrocyanide, dithizone, salicylic acid, iodide, and diethyldithiocarbamate. It is concluded that the best results are given by the ammonia determination using a red filter, and that, generally, colorimetric analysis is worthy of greater consideration.—E. N.

Application of the Photocolorimeter in Volumetric Analysis. Yu. Yu. Lur'e and E. M. Tal (*Zavod. Lab.*, 1940, 9, 702-714; *Brit. Chem. Abs.*, 1943, [A I], 316).—[In Russian.] In the simplest cases the light absorption of the solution is measured after three additions of standard solution, one being before and two after the end-point has been reached; the end-point is the crossing of the straight lines drawn through the zero point and the first measured point, and through the two other measured points. This method is used for permanganometry (determination of Fe in presence of coloured cations, e.g., Ni and Co) and alkalimetry in the presence of phenolphthalein. A suitable light filter facilitates the titration. In more complicated cases, when the solution is coloured throughout (titration with methyl orange, methyl red, &c.), the light absorption must be measured for many additions, and the end-point found graphically. The method is indicated for coloured solutions, e.g., for determining the acidity of commercial Ni and Co sulphates and of Ni and Co electroplating baths.

\*A Contribution to the Working Technique of Polarographic Analysis. A. Dravnieks and M. Straumanis (*Z. anal. Chem.*, 1942, 124, (1/2), 31-34).—A new type of self-contained cell is described, which has the following advantages: (1) contamination of the mercury with rubber and grease is avoided, (2) the drop rate can be easily regulated and the drops instantly checked, and (3) the anode is smaller than usual. Methods for the purification and storage of the mercury are discussed.—E. N.

\*Determination of Traces of Aluminium with Aluminon. L. M. Kulberg and E. I. Rovinskaya (*Zavod. Lab.*, 1940, 9, 145-148; *Brit. Chem. Abs.*, 1943, [A I], 316).—[In Russian.]  $10^{-6}$ – $10^{-5}$  g. of Al can be determined in the presence of  $<4$  mg. of Ca,  $<0.5$  mg. of Mg,  $<2 \times 10^{-5}$  g. of Cu, Mn, and Zn, and  $<3$  mg. of  $\text{PO}_4^{3-}$ , if the solution contains also 0.5–2 mg. of  $\text{Fe}^{3+}$ . Al + Fe are precipitated with 8-hydroxyquinoline in dil.  $\text{CH}_3\text{COOH}$  at  $50^\circ\text{C}$ ., and the precipitate is transformed into chlorides and extracted with 50% KCNS and  $(\text{C}_2\text{H}_5)_2\text{O}$ . The residue is transformed into Al aurintricarboxylate and the colour intensity measured with a photo-cell using a green filter, since the absorption maximum of the salt is 530 m $\mu$ .

\*Identification of the Cations of Arsenic and of Some Neighbouring Elements (Antimony, Tin, and Cerium).—I.-II. P. Wenger, R. Duckert, and J. Renard (*Helv. Chim. Acta*, 1945, 28, (6), 1309-1315; (7), 1479-1489).—[In French.] [I.—] Reagents for trivalent and pentavalent As and some allied cations are considered in detail, with numerous bibliographical references. Only two

reagents—aluminium + KOH + HgCl for trivalent As and ferrous molybdate for pentavalent As—are considered sufficiently sensitive and reliable; discrimination between trivalent and pentavalent As in the presence of each other remains a problem. For trivalent Sb methyl-9-*m*-hydroxy-2:3:7-fluorone-6 is recommended. [II.—] The reactions of a large number of phenolic derivatives in the presence of As, Sb, Sn, and Ce compounds have been studied. Characteristic reactions were observed only for pentavalent As and Sb and tetravalent Sn and Ce. Pyrocatechol can be used for the detection of pentavalent in the presence of trivalent As; pentavalent Sb reacts characteristically with *o*-carboxy-pyrogallol under suitable conditions, and Sb<sup>++++</sup> and Ce<sup>++++</sup> quickly oxidize hydroquinone to quinhydrone.—P. R.

**Critical Study of Reagents for Cations. XVII.—Reagents for Beryllium.** Paul Wenger, Roger Duckert, and Y. Rusconi (*Helv. Chim. Acta*, 1945, 28, (5), 925-929).—[In French.] Non-recommended and recommended reagents are separately tabulated, the latter group consisting of pentanedione-2:4 (acetylacetone), quinalizarin + ethylenediamine, and *p*-nitrobenzene-azo-orninol.—P. R.

**\*Volumetric Determination of Chromium and Vanadium.** Lucien Ducret (*Bull. Soc. Chim. France*, 1943, [v], 10, 334-338; *C. Abs.*, 1944, 38, 4213).—From a study of oxidation potentials, a procedure is proposed for determining Cr and V in the presence of one another. After oxidizing to Cr<sub>2</sub>O<sub>7</sub><sup>==</sup> and H<sub>3</sub>VO<sub>4</sub>, the solution is treated with a measured volume of standard FeSO<sub>4</sub> solution, which causes reduction to Cr<sup>+++</sup> and VO<sup>+</sup>. Then by titrating with K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> in the presence of Ba diphenylamine sulphonate only the excess Fe<sup>++</sup> is oxidized and from the titration the equivalent of Cr + V is known. Then, at a different pH, the VO<sup>+</sup> is oxidized back to H<sub>3</sub>VO<sub>4</sub> by KMnO<sub>4</sub> in the presence of ferrous *o*-phenanthroline as indicator. The Cr is then known by difference.

**Critical Study of Reagents for Cations. XV.—Reagents for Indium.** P. Wenger, R. Duckert, and Y. Rusconi (*Helv. Chim. Acta*, 1945, 28, (3), 539-542).—[In French.] Analytical reagents for the detection and separation of In, especially for micro-analysis, are tabulated in two groups. The first contains reagents whose use is not recommended, the reason being shown in each case. The second group, containing only (a) hexamethylenetetramine + ammonium thiocyanate, and (b) dihydroxy-1:2 anthraquinone (alizarin), gives bibliographical references, method of use, temperature, sensitivity, nature of reaction, dilution limits, and "masking" or "interfering" cations.—P. R.

**\*A New Method of Fractionating the Rare Earths (with Nitrilo-Triacetate); Separation of Lanthanum and Cerium.** G. Beck (*Helv. Chim. Acta*, 1946, 29, (2), 357-360).—The mixed oxalates and/or fluorides of the rare-earth metals are dissolved in nitrilo-triacetate. Ce is precipitated quantitatively and free from didymium if a faintly alkaline solution is treated with H<sub>2</sub>O<sub>2</sub>; La is precipitated from an oxalate solution by acidifying with acetic acid. The method is also applicable to Sm-Gd mixtures.—P. R.

**\*A Critical Investigation of Lead Determination by the Chromate Method.** Friedrich Grote (*Z. anal. Chem.*, 1941, 122, (11/12), 395-399).—The Pb was precipitated from a boiling ammonium acetate and acetic acid solution by 0.5*N*-K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>, boiling being carried on for a further 10 min. After cooling and standing for 2 hr., the precipitate was filtered off, washed with distilled water, and then dried for 1 hr. at 105° C., and 2 hr. at 160° C. It is shown that the use of the empirical factor 0.6378 in place of the theoretical factor 0.6411 gave results in good agreement with the sulphate method to ±0.05%. (See also abstract below).—E. N.

**\*The Adsorptive Properties of Lead Chromate and Their Influence on the Analytical Determination of Lead as Lead Chromate.** Friedrich Grote (*Z. anal. Chem.*, 1943, 126, (4), 129-132).—Continues the investigation of the



chromate determination of Pb (see previous abstract). When Pb is estimated gravimetrically as  $\text{PbCrO}_4$  by precipitation from acetic acid solutions with  $\text{KCrO}_4$  or  $\text{K}_2\text{Cr}_2\text{O}_7$ , there is a uniform adsorption of  $\text{CrO}_4^{2-}$  in the  $\text{PbCrO}_4$ . To compensate for this the empirical factor 0.6378 should be used. Variations in the methods of adding the precipitation reagent, lengthening of the drying time and increasing the drying temperature from  $160^\circ$  to  $200^\circ \text{C}$ . are shown to be without influence on the weight of the precipitate.—E. N.

**\*On the Thiocyanate Volumetric Method for the Determination of Mercury.** Z. Karaoglanov (*Z. anal. Chem.*, 1943, 125, (11/12), 406–416).—An investigation of the thiocyanate estimation of Hg is described. The method was found to be reliable if carried out under the following conditions: (1) the Hg should be present as mercuric nitrate or sulphate, (2) there should be excess  $\text{HNO}_3$  and a sufficiency of indicator solution, which may be either ferric nitrate or iron alum, (3) if phosphates are present, the quantities of  $\text{HNO}_3$  and indicator solution must be increased, (4) halogens must be absent, (5) the titration must be carried out at room temperature, as warm solutions give erroneous results. The Hg can be titrated by the thiocyanate or the thiocyanate by the Hg. The preparation of a standard Hg solution is described;  $\text{AgNO}_3$  can also be used for this purpose, but care must be taken to reach the final end-point. The theory of the reaction is discussed, together with the conditions which lead to complex salt formation between: (a) the thiocyanates of mercury, iron, and ammonia, and (b) ferric and phosphate ions.—E. N.

**Critical Study of Reagents for Cations. XVI.—Reagents for Scandium.** P. Wenger, R. Duckert, and Y. Rusconi (*Helv. Chim. Acta*, 1945, 28, (5), 872–875).—[In French.] Non-recommended and recommended reagents for Sc are separately tabulated, grounds for criticism being indicated. Recommended reagents are hexammino-cobalt nitrate (luteo-cobaltic series) + NaF, and commercial tincture of cochineal.—P. R.

**\*On the Iodine Determination with the Aid of Ferric Chloride and Its Application to the Separation from Chlorine Ions and to the Determination of Silver.** W. Erber (*Z. anal. Chem.*, 1942, 123, (5/6), 161–165).—The oxidation of iodine by  $\text{FeCl}_3$ , according to the equation  $\text{Fe}^{3+} + \text{I}^- = \text{Fe}^{2+} + \frac{1}{2}\text{I}_2$ , was investigated as a rapid and quantitative method for use in the determination of iodine. The solution, with an iodine concentration of  $>0.012N$ , has 0.6–1.2% of  $\text{FeCl}_3$  and 2–12% of HCl added and is heated for 8–9 min. at  $60^\circ \text{C}$ . It is cooled, the excess  $\text{Fe}^{3+}$  neutralized by NaF, diluted, and the iodine titrated with  $0.1N\text{-Na}_2\text{S}_2\text{O}_3$  solution, after the addition of 2–3 c.c.  $\text{CCl}_4$  and using starch as indicator. Under these conditions the method is quantitative, a reliable separation being obtained when chlorine is present within very wide limits and if bromine is not in excess of  $0.2N\text{-HBr}$ . The method can be adapted for the microchemical determination of Ag. The Ag, of approx. known composition (if as  $\text{AgCl}$  it is dissolved in  $\text{NH}_4\text{OH}$ ), is treated with a known volume of  $0.1N\text{-KI}$  solution, so that it contains an excess of 0.5–3 c.c. of KI, diluted to 40 c.c. and the excess iodine determined as described above. With Ag contents of 5.7–284.6 mg.  $\text{AgCl}$  the error was found to be 0.3–1.4 mg. of  $\text{AgCl}$ .—E. N.

**\*Estimation of Traces of Sodium in Aluminium of Very High Purity by Spectral Analysis.** F. Rohner (*Helv. Chim. Acta*, 1944, 27, (2), 268–273).—[In German.] Na in high-purity Al can be estimated spectrographically either by sparking small cast rods of the metal or by using a solution, e.g., that prepared for check analysis by the uranyl acetate method, with a glass or quartz spectrograph. The *D*-lines can then be distinguished against the Al band, the second *D*-line being more readily seen if a glass spectrograph is used. Owing to the possible segregation of Na in the Al, 4 parallel estimations should be made.—P. R.

**\*Estimation of Traces of Sodium by Spectral Analysis of Solutions.** F. Rohner (*Helv. Chim. Acta*, 1944, 27, (3), 572–575).—[In German.] Na

can be estimated spectro-analytically in solutions containing down to 0.003 g. of Na per litre; the method is applicable to solids containing Na provided that Na-free solvents are available. An account is given of the estimation of Na in high-purity Al (see also preceding abstract). The solution is sparked between carbon electrodes. The method, though very laborious and having only one-tenth the sensitivity of the ordinary spectrographic analysis of metal specimens, eliminates segregation effects and is also recommended because of the ease with which standard solutions can be prepared.—P. R.

**\*Polarimetric Estimation of Sodium in Aluminium and Aluminium Alloys.** P. Urech and R. Sulzberger (*Helv. Chim. Acta*, 1944, 27, (5), 1074–1079).—[In German.] A modification of Heyrovsky's polarimetric method has been applied to the analysis of untreated or remelted specimens of aluminium and of Raffinal (aluminium of 99.991–99.997% purity). The sample is dissolved in tetramethylammonium hydroxide, most of the Al is precipitated as chloride by passing HCl gas, and the mother-liquor concentrated. Several estimations are necessary to establish the "blank" polarization curve. A tabulation of results shows that the accuracy attainable considerably exceeds that obtained by spectrographic methods. (See also abstracts above of papers by F. Rohner.)—P. R.

**\*Titrations with Solutions of Chromous Salts. II.—The Chromometric Estimation of Tungsten and Uranium.** R. Flatt and F. Sommer (*Helv. Chim. Acta*, 1944, 27, (6), 1518–1522).—[In German.] The estimation of W can be carried out by converting the salt to ammonium tungstate (5–20 mg./litre), strongly acidifying with HCl, and titrating with chromous chloride in a specially designed apparatus (see *ibid.*, 1942, 25, 684) in which changes in electrical conductivity can be observed. The end-point of the reaction is marked by a sharp drop in voltage, corresponding with the complete reduction of hexavalent to tetravalent W. U is similarly estimated, preferably in the presence of a trace of Fe, hexavalent being reduced to tetravalent U.—P. R.

**\*Titrations with Chromous Salts. III.—The Chromometric Estimation of Fe, Cu, Ti, V, Cr, Mo, and W in Mixtures.** R. Flatt and F. Sommer (*Helv. Chim. Acta*, 1944, 27, (6), 1522–1532).—[In German.] An apparatus (*ibid.*, 1942, 25, 684) which permits the observation of changes in conductivity has been used for the estimation, by titration with chromous chloride, of the following metals in presence of each other: Fe and Ti; Fe and V; Fe and Mo; Mo and Cu; Mo and Ti; Mo and V; W and Fe; W and Cu; W and Cr; W and Mo; Fe, Mo, and W. In each case the reaction noted is a reduction by the chromous salt, and the end-point is marked by a drop in potential. The reduction of one constituent of the mixture apparently becomes complete before that of the second constituent begins.—P. R.

**\*Micro-Separation of Zinc from Aluminium by Means of Potassium Ethylxanthogenate.** Paul Wenger, E. Abramson, and Z. Besso (*Helv. Chim. Acta*, 1946, 29, (1), 49–51).—Potassium ethylxanthogenate precipitates Zn quantitatively from a solution slightly acidified with acetic acid and containing sodium acetate; Al is not precipitated. Accurate micro-separation is practicable for mixtures containing Al and Zn cations in the proportions 25 : 75 to 75 : 25.—P. R.

**Critical Study of Reagents for Cations. XVIII.—Reagents for Zirconium.** Paul Wenger, Roger Duckert, and Y. Rusconi (*Helv. Chim. Acta*, 1945, 28, (5), 929–934).—[In French.] Non-recommended and recommended reagents are separately tabulated. The latter group includes rubidium chloride + ammonium fluoride, carminic acid, sodium alizarinsulphonate, and dimethyl-amino-4-phenylazo-phenylarsinic-4 acid.—P. R.

**\*Rapid Determination of Zirconium.** T. A. Uspenskaya, E. I. Guldina, and M. S. Zverkova (*Zavod. Lab.*, 1940, 9, 142–145; *Brit. Chem. Abs.*, 1943, [A I], 317).—[In Russian.] A solution of 0.2 g. of Zr in 5% HCl is mixed with



1.5 c.c. of 0.03% alizarin and with enough 0.1N-NaF to produce a yellowish-pink colour. To another solution containing the same amounts of HCl, alizarin, and NaF, a titrated solution of  $\text{ZrOCl}_2$  is added to give the same colour.  $\text{Fe}^{+++}$  and  $\text{SO}_4^{--}$ , but not  $\text{Fe}^{++}$ , interfere.

**A New General Method of Cation Analysis, Based on the Use of Potassium Ethylxanthate.**—I.—II. P. Wenger, R. Duckert, and E. Ankadji (*Helv. Chim. Acta*, 1945, 28, (6), 1316–1325; (7), 1592–1606).—[In French.] Cf. *Met. Abs.*, this vol., p. 58. [I.—] Potassium ethylxanthate is proposed as a “group” reagent in place of  $\text{H}_2\text{S}$ . The proposed reagent is soluble in water and in common organic solvents containing oxygen; alcoholic solutions are more stable than aqueous ones. Non-reacting cations include the alkali and alkaline-earth metals, Al, Sc, Y, Me,  $\text{Ce}^{\text{III}}$ ,  $\text{Ti}^{\text{III}}$ ,  $\text{Ti}^{\text{IV}}$ ,  $\text{Zr}^{\text{IV}}$ ,  $\text{Hf}^{\text{IV}}$ ,  $\text{Th}^{\text{IV}}$ ,  $\text{Mn}^{\text{II}}$ ,  $\text{Re}^{\text{III}}$ . Full descriptions are given of the reactions of the remaining cations (excluding certain rare elements) at 15° C. and a number of pH values. The reactions have been carried out in the presence of a large number of anions, a list of which is given; most of them do not influence the result. Excess of the reagent is removed by oxidation, resulting in the formation of sulphates, or by treatment with caustic alkali, which produces hydroxides and/or thio-compounds. [II.—] The systematic separation of metallic cations by means of potassium ethylxanthate is described. The metals should preferably be present as chlorides or sulphates, in a solution free from phosphates or organic acids; recommendations are made for the preparation of such solutions in analysing organo-metallic compounds, salts of organic or inorganic acids, minerals, metals, or alloys. The successive stages in the separation are: (1) Precipitation of Ag,  $\text{Hg}^{\text{I}}$ ,  $\text{Ti}^{\text{I}}$ , Pb as chlorides; (2) precipitation of Pb, Ba, Ca, Sr as sulphates; (3) precipitation of  $\text{Hg}^{\text{II}}$ ,  $\text{Cu}^{\text{II}}$ ,  $\text{Bi}^{\text{III}}$ ,  $\text{As}^{\text{III}}$ ,  $\text{As}^{\text{V}}$ ,  $\text{Sb}^{\text{III}}$ ,  $\text{Sb}^{\text{V}}$ ,  $\text{Sn}^{\text{II}}$ ,  $\text{Sn}^{\text{IV}}$ ,  $\text{Au}^{\text{III}}$ ,  $\text{Rh}^{\text{III}}$ ,  $\text{Pd}^{\text{II}}$ ,  $\text{Os}^{\text{IV}}$ ,  $\text{Pt}^{\text{IV}}$ ,  $\text{Se}^{\text{IV}}$ ,  $\text{Se}^{\text{VI}}$ ,  $\text{Te}^{\text{IV}}$ ,  $\text{Te}^{\text{VI}}$ ,  $\text{Mo}^{\text{V}}$ ,  $\text{Mo}^{\text{VI}}$ ,  $\text{Re}^{\text{III}}$ ,  $\text{Re}^{\text{VII}}$ ,  $\text{Co}^{\text{II}}$ ,  $\text{Ni}^{\text{II}}$ , with potassium ethylxanthate, Se and Te being precipitated uncombined; most of these xanthates are dissolved as thio-compounds on treatment with warm caustic alkali, Cu, Bi, Rh, Pd, Os, Pt, Re, Co, and Ni being precipitated as sulphides; (4) precipitation of hydroxides or sulphates of  $\text{Cd}^{\text{II}}$ ,  $\text{Ge}^{\text{IV}}$ ,  $\text{Fe}^{\text{II}}$ ,  $\text{Cr}^{\text{III}}$ ,  $\text{O}_2\text{U}^{\text{II}}$ ,  $\text{Ce}^{\text{III}}$ ,  $\text{Y}^{\text{III}}$ ,  $\text{Ti}^{\text{IV}}$ ,  $\text{Th}^{\text{IV}}$ ,  $\text{Ti}^{\text{III}}$ ,  $\text{Sc}^{\text{III}}$ ,  $\text{In}^{\text{III}}$ ,  $\text{Mn}^{\text{II}}$ ,  $\text{Mg}^{\text{II}}$  with caustic alkali. Ru, [Os], Ir, U, Al, Be, [Ti], Ga, [In], Zn, [Ca] and the alkali metals remain in solution. Directions are given for isolating the members of each group, and a list of anions likely to interfere with the reactions is given.—P. R.

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

(See also “Testing” and “Temperature Measurement and Control.”)

\*An Accurate Cooling Method for the Absolute and Relative Determination of the Temperature Variation of the True Specific Heat of Metals. Adolf Knappwost (*Z. Elektrochem.*, 1943, 49, (1), 1–6).—Previous methods of determining the specific heat of metals are reviewed and a new form of apparatus is described. The cylindrical specimen with a narrow axial hole drilled almost to the bottom, is heated to about 250° C. and inserted into a hollow aluminium cylinder, in which it rests on and is centred by small quartz or glass rods, leaving an air space of about 0.2 cm. around it. A copper-Constantan thermocouple is inserted into the hole in the specimen and the aluminium cylinder closed with a gas-tight lid, through which the thermocouple wires pass and are connected to a galvanometer reading to 0.01° C. The lid is fitted with two stopcocks which permit evacuation and introduction of another gas, air or hydrogen. Measurements of the capacity of the arrangement as a condenser enables the thermal conductivity of the gas layer between the specimen and container to be calculated. The aluminium container is immersed in an

ice-water mixture and measurements are made of the rate of change of temperature at the centre of the specimen. Equations are developed for calculating the thermal conductivity of the metal from the results obtained.—E. N.

**\*An Arrangement for the Rapid Photographic Recording of Magnetostriction Curves.** Max Kornetzki (*Wiss. Veröff. Siemens-Werken*, 1941, 20, (2), 48-53; *Elect. Eng. Abs.*, 1943, 46, 109).—The change in length of the specimen is transferred through a lever system to one plate of a capacitor supplied with current at 35 kc./sec. Results for various iron-cobalt alloys, "Sendust," and "1040" high-permeability alloys, are given.

**Metallurgical Aspects of X-Ray Tube Manufacture.** M. J. Zunick (*Iron Age*, 1946, 157, (15), 56-59).—Some of the unusual operations involved in X-ray tube manufacture are described, including casting of the anodes, mounting of the filament, preparation of the tungsten targets, glass-to-metal sealing, and tube exhaustion. From a metallurgical point of view, the important requirements are: (1) density and melting points of targets and anode castings, (2) purity of the metals with respect to both metal and gas impurities, (3) cleanliness of surfaces and absence of low-melting constituents, and (4) chemical composition.—J. H. W.

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

**New Ideas for the Estimation of the Elastic Limit and Proof Stress.** Wilhelm Späth (*Arch. Eisenhüttenwesen*, 1943, 16, (11/12), 465-468).—It is pointed out that the usual method of determining the proof stress as that stress which is required to produce a fixed permanent deformation has certain disadvantages. These are discussed, and it is suggested that the required permanent deformation to be used to obtain comparable results for different materials should be proportional to the elastic deformation. The derivation of suitable values for the permanent deformation is discussed, together with the potentialities of the new method.—G. V. R.

**A New Approximate Method of Measuring the Percentage Elongation of Metals at Fracture.** A. I. Mikhailov (*Vestn. Metalloprom.*, 1939, 19, (7), 71; *Elect. Eng. Abs.*, 1944, 47, 74).—[In Russian.] An empirical relation is established between percentage elongation ( $\delta_{10}$ ) at fracture (as obtained in tensile tests on cylindrical specimen with length =  $10 \times$  dia.), and deformation when undergoing a Brinell indentation test with a 5-mm. ball at 750 kg.

**\*Systematic Investigation of the Applicability of Journal-Bearing Materials.** E. Heidebroek (*Automobiltechn. Z.*, 1942, 45, 652-656; *Chem. Zentr.*, 1943, 114, (II), 465; *C. Abs.*, 1944, 38, 5480).—A special laboratory testing machine is described with which ten different bearing metals were studied with regard to friction coeff. for speeds up to 15 mm./sec., lubrication, and loads up to 600 kg./sq. cm. The tests show that loads of over 400 to 600 kg./sq. cm. cannot be satisfactorily applied in practice with the present known materials.

**Inspection of Bronze Bearings for Aircraft.** Francesco Villani (*Met. Ital.*, 1943, 35, 59-66; *Chem. Zentr.*, 1943, 114, (II), 771; *C. Abs.*, 1944, 38, 5784).—Aircraft bearings of lead bronze should be examined by X-rays; the Seifert apparatus can be used for this purpose. A nomograph for determination of exposure time as a function of bearing thickness is given, and X-ray pictures of sound and faulty bearings of 80 : 20 and 75 : 25 copper-lead alloys are shown. The main defects are segregation (especially if the lead content is over 20%), large grain-size, and porosity.

**Automaton Bubble-Tests Light-Metal Castings.** Roy Cummings (*Machinist (Eur. Edn.)*, 1946, 90, (1), 32-33).—Pressure testing of hollow aluminium and magnesium castings is intensified and accelerated by the use of a semi-automatic pressure-testing fixture, which is here described.—J. H. W.



**Structural Experiments and Determination of Internal Stresses of Metallic Materials by X-Rays.** Edmondo Di Giacomo (*Il Calore*, 1942, 15, 148–160, 176–182).—A review.

### RADIOLOGY

**Relationship of X-Ray Inspection to Light Metals Foundry Control.** Robert Taylor (*Aluminum and Magnesium*, 1945, 1, (11), 20–24).—The advantages of radiographic inspection from the point of view of correcting faulty foundry technique and of rejecting faulty castings are discussed. The appearance of the common defects on the X-ray negative is described, and an elementary account of radiographic technique is given.—E. C. E.

**Fluoroscopy of Light Alloy Castings.** B. Casson and D. S. Clark (*Iron Age*, 1946, 157, (16), 48–50).—See *Met. Abs.*, this vol., p. 99. The basis for acceptance or rejection of castings on fluoroscopic tests must be a rational one, and the significance of observed defects on the usability of castings and the use of higher X-ray voltages to obtain greater screen brightness, are discussed.—J. H. W.

**Industrial X-Ray Developments.** C. D. Moriarty (*Elect. Eng.*, 1945, 64, (12), 433–435).—Advances in the production of X-ray materials and methods of recording X-ray results are reviewed, and some applications are given.—E. V. W.

**A Survey of X-Rays in Engineering and Industry.** V. E. Pullin (*J. Inst. Elect. Eng.*, 1945, [I], 92, (54), 226–233; discussion, 233–238).—P. deals with (1) the development of the X-ray technique from the time of Röntgen's discovery, (2) its use during the war, and (3) possible future developments. Only the radiographic aspect is considered.—E. V. W.

**Problems of a Small Gamma-Ray Department.** John H. G. Williams (*Indust. Radiography*, 1942, 1, (2), 35–37; *C. Abs.*, 1944, 38, 3544).—Numerous miscellaneous features of gamma-ray work are discussed, including protection, an adjustable support for the radium capsule, the use of a calibrated density strip for approximate measurements of density, and the properties of the characteristic curve of the film.

## XIV.—TEMPERATURE MEASUREMENT AND CONTROL

**An Electronic Potentiometer Pyrometer.** J. J. Fraser (*Electronic Eng.*, 1945, 17, 340–344; *Elect. Eng. Abs.*, 1945, 48, 169).—The instrument described measures temperature by balancing the e.m.f. generated by the thermocouple against a known voltage from a battery. The operating principle is discussed and the various components are studied. The balancing circuit is continuous, and not periodic. It is claimed that the instrument possesses several advantages over those normally used in pyrometry, e.g., stability of calibration, greater accuracy, robustness, speed of operation, &c.

## XV.—FOUNDRY PRACTICE AND APPLIANCES

†**Fundamental Principles Involved in Segregation in Alloy Castings.** R. M. Brick (*Trans. Amer. Inst. Min. Met. Eng.*, 1945, 161, 65–72; discussion, 72–74).—See *Met. Abs.*, 1945, 12, 30.

**Symposium on Continuous Casting : Opening Remarks.** Carl E. Swartz (*Trans. Amer. Inst. Min. Met. Eng.*, 1945, 161, 478–479); †**Continuous Casting Yesterday and To-Day.** T. W. Lippert (*ibid.*, 479–486); †**The Continuous Casting of Molten Metals—History, Requirements, Metallurgy, and Economics.** N. P. Goss (*ibid.*, 487–510; discussion, 510–511); **Improvements in the Direct Rolling of Strip Metal.** C. W. Hazlett (*ibid.*, 512–514); **The Soro**

Process [of Casting]. E. I. Valyi (*ibid.*, 514-519); The Williams Process of Casting Metals. Edward R. Williams (*ibid.*, 520-523).—See *Met. Abs.*, 1945, 12, 229-230.

**Treatment and Casting of Metals by Electromagnetic Forces.** W. W. Hoke (*Trans. Amer. Inst. Elect. Eng. (in Elect. Eng.)*, 1944, 63, 986-992; *Elect. Eng. Abs.*, 1945, 48, 288).—A discussion of the normal forces exerted on impurity particles in a mass of molten metal is followed by examination of how the application of a unidirectional electromagnetic field through the metal increases the forces which assist in the elimination of impurities by increased buoyancy. The beneficial effect of a superimposed A.C. field in forcing impurities towards the top of the metal under treatment is outlined. It is shown to be possible to regulate the current through the metal on cooling so as to cause it to solidify from the bottom upwards. The method is claimed to eliminate all comparatively non-conductive undissolved impurities from the treated metal. The application of electromagnetic force on a casting permits greater complexity of casting with greatly reduced casting pressure. A special application to the casting of dental forms is described.

**Degassing and Pouring Aluminium.** Hiram Brown (*Modern Metals*, 1945, 1, (2), 12-17).—The degassing of molten aluminium, the control of temperature, and the pouring into sand and permanent moulds, is described and illustrated.—L. H.

**British Aluminium Permanent-Mould Practice.** Jack W. Wheeler (*Modern Metals*, 1945, 1, (8), 8-12).—It is expected that aluminium die-castings will be employed in many ways in the new British automobiles. Close co-operation between foundry and consumer has a direct bearing on low-cost production.

—L. H.

**Centrifugal Casting Aluminium.** — (*Modern Metals*, 1946, 1, (12), 14-16).—The process, design characteristics, production equipment, production methods, and control are discussed.—L. H.

**Chills for Light Alloy Castings.** A. E. Cartwright (*Aluminum and Magnesium*, 1945, 2, (3), 23-24, 38).—Aluminium is effective as a chill material for light alloy castings on account of its high specific heat, latent heat of fusion, and thermal conductivity. It was shown experimentally that of the four materials, cast iron, copper, aluminium-5% silicon alloy and magnesium-8% aluminium alloy, cast iron was best and the aluminium-base alloy next best as a chill material for aluminium-4% copper alloy.—E. C. E.

**Aluminium Bronze Permanent-Mould Castings.** B. Johnson (*Iron Age*, 1946, 157, (14), 80-83).—Details are given of mould construction and of the casting operations for casting aluminium bronze, containing copper 85-88, aluminium 10-11, iron 2-3%, in gravity-filled die moulds to produce castings having superior hardness, grain and surface characteristics, and with close tolerances.—J. H. W.

**The Loss of Metal in the Casting of Brass and Its Prevention.** Gillis Em. Huss (*Tekn. Tidskr.*, 1942, 72, 443-446; *Chem. Zentr.*, 1943, 114, (I), 671; *C. Abs.*, 1944, 38, 3582).—The following measures will, to a large extent, prevent loss of metal: preheating of the metal before its introduction into the crucible, covering the metal with 2-3 cm. of powdered charcoal before fusion begins, regulation of the combustion in the furnace, stirring the melt, avoiding heating above the casting temperature, pyrometric control of the temperature of the melt, and rapid casting after the casting temperature is reached, especially when the casting temperature required is high.

**Fundamentals of Pouring Magnesium Sand-Cast Alloys.** E. J. Vargo (*Aluminum and Magnesium*, 1946, 2, (4), 14-17, 21).—A discussion of the melting of magnesium and the pouring of the molten metal in the mould. Melting under a flux is carried out in tilting furnaces holding 2000 lb., the charge consisting of 20% virgin ingot and balance segregated scrap, from which all



sand is cleaned. The molten metal is transferred to steel crucibles and refined by stirring in refining flux for 2 min. at 1300–1350° F. (687–715° C.). The metal is then superheated to 1650–1700° F. (881–909° C.) with exact temperature control. The pots are removed from the furnace and cooled to pouring temperature. The flux is dry after superheating, and burning at this stage is controlled by the use of dusting fluxes containing sulphur, boric acid, and ammonium borofluoride. The moulds are filled with SO<sub>2</sub>, the crucible lip is cleaned and the flux crust removed or held back, and the metal is poured. A pouring box is used on the mould to act as a reservoir of molten metal and to trap oxides. The pot is never emptied completely. The defects which may result from malpractice during pouring are listed and the probable causes are given.—E. C. E.

\***A Study of Factors Influencing Grain-Size in Magnesium Alloys and a Carbon-Inoculation Method for Grain Refinement.** [Tensile Properties of Magnesium Alloys.] C. H. Mahoney, A. L. Tarr, and P. E. Le Grand (*Trans. Amer. Inst. Min. Met. Eng.*, 1945, 161, 328–347; discussion, 347–350).—See *Met. Abs.*, 1945, 12, 373.

\***Grain Refinement of Magnesium Alloys Without Superheating.** Ralph Hultgren and David W. Mitchell (*Trans. Amer. Inst. Min. Met. Eng.*, 1945, 161, 323–327).—See *Met. Abs.*, 1945, 12, 373.

\***Grain Refinement of a Carbothermic Magnesium Alloy by Superheating.** Ralph Hultgren, David W. Mitchell, and Bernard York (*Trans. Amer. Inst. Min. Met. Eng.*, 1945, 161, 315–322).—See *Met. Abs.*, 1945, 12, 374.

\***Oxidation Inhibitors in Core-Sand Mixtures for Magnesium Castings.** O. Jay Myers (*Trans. Amer. Inst. Min. Met. Eng.*, 1945, 161, 253–261; discussion, 261–265).—See *Met. Abs.*, 1945, 12, 230.

**Magnesium Foundry.** — (*Aluminum and Magnesium*, 1945, 2, (1), 31–34; (2), 22–25; (3), 25–24).—An account of the new foundry of Messrs. J. Stone and Co., Ltd.; see *Met. Abs.*, 1945, 12, 297.—E. C. E.

**Impregnating Magnesium Castings.** Samuel A. Moore (*Iron Age*, 1946, 157, (11), 76–80).—The behaviour of various types of agents for sealing up the microporosity of magnesium castings is described, with particular reference to the relation of baking time and pressure to the efficacy of the sealing action. The impregnating properties of a newly-developed resin-styrene, “No. 988,” are also described. This compound is non-thermoplastic and does not require an expensive chemical catalyst.—J. H. W.

**Babbling Large Cast-Iron Bearing Shells.** L. F. Train (*Iron Age*, 1946, 157, (14), 84–85).—The method of babbling cast-iron is described in which the half bearing shell is completely immersed in a tinning bath in an especially constructed furnace.—J. H. W.

**A Buyer Looks at Some Foundry Problems.** R. V. Elms (*Aluminum and Magnesium*, 1946, 2, (4), 18–21).—The need for the buyer to state his specifications more exactly, and for the average small foundry to meet these requirements by increasingly exact control, is stressed.—E. C. E.

**Thermal Reclamation of Sand.** Gordon H. Curtis (*Aluminum and Magnesium*, 1946, 1, (12), 16–20).—C. describes the reclamation of sand in a foundry using upwards of 300 tons of sand a day. All moulds are assembled from baked oil-bonded cores and no clay-bonded sand is used. The used sand is roasted in a multiple-hearth ore-roasting furnace to about 1500° F. (798° C.), at which temperature the carbonaceous material from the binder, sulphur, and inhibitors if present are oxidized or decomposed and driven off. About 5% of raw sand is required per cycle and the reclaimed sand is as good as the original sand. A flow diagram of the process is given.—E. C. E.

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

**Secondary Aluminium and Aluminium Alloys.** Louis Frenot (*Rev. Aluminium*, 1945, (117), 164–170).—F. describes the work and recommendations of the French Technical Committee on Secondary Aluminium. The aluminium scrap was segregated into the following groups. Group 1. *Pure metal*: (a) 99.8%, (b) 99.5%, and (c) 98–99.4%. Group 2. *Sheet and forgings*: (a) aluminium–copper with magnesium and manganese, (b) aluminium–magnesium–silicon, (c) aluminium–magnesium, and (d) aluminium–copper–nickel–magnesium. Group 3. *Casting alloys*: (a) aluminium–copper (4–12%), (b) aluminium–copper–silicon (5% Cu, 4% Si), (c) aluminium–silicon–magnesium (5% Si, 1% Mg), (d) aluminium–silicon (13%), (e) aluminium–silicon–copper (15% Si, 2.3% Cu), (f) aluminium–magnesium, and (g) miscellaneous. Tables showing the composition limits and mechanical properties of the various groups of alloys are given. The alloys are also classified according to their behaviour during anodizing. Uses for which the various alloys are suitable are given.—E. C. E.

**[U.S.] Navy Recovers Aluminium from Aircraft.** Donald L. Colwell (*Modern Metals*, 1945, 1, (9), 8–12).—A review of the policy and technique applied in the disposal of obsolete and worn-out military aircraft is given.

—L. H.

**The Influence of Scrap Aluminium on the Post-War Market [in America].** N. H. Engle (*Aluminum and Magnesium*, 1945, 2, (2), 18–21, 27).—E. C. E.

**Recovery of Non-Ferrous Heavy Metals.** R. Piontelli (*Met. Ital.*, 1942, 34, 394–396; *Chem. Zentr.*, 1943, 114, (II), 272; *C. Abs.*, 1944, 38, 4888).—A critical survey of the working up of copper, lead, zinc, &c.

**Detinning Plant Uses 20,000-Foot Pipe.** C. P. Stolberg (*Heating and Ventilating*, 1944, 41, 41–43; *C. Abs.*, 1944, 38, 5192).—Discarded tin cans are freed from tramp iron and other material having no tin content, shredded, incinerated in an oven, and washed. Cleaned cans are detinned in NaOH solution, from which tin oxide is precipitated, filtered, dried, and packed for shipment.

## XVII.—FURNACES, FUELS, AND REFRACTORY MATERIALS

**Some Recent Heat-Treatment Furnace Installations.** — (*Metallurgia*, 1946, 34, (199), 29–40).—A review of furnace installations developed recently for the heat-treatment of both ferrous and non-ferrous metals includes descriptions of a roller-hearth furnace for clean-annealing non-ferrous material; of a continuous roller-hearth gas-fired furnace for bright-annealing; of furnaces for light alloy heat-treatment, including conveyor, pusher, and tubular furnaces; and of different types of furnaces for brazing.—J. W. D.

**Furnaces and Heat-Treatment for Permanent-Mould Magnesium Castings.** A. V. Keller (*Modern Metals*, 1945, 1, (7), 20–21, 23).—K. explains the building and operation of a heat-treating furnace and discusses some of the causes responsible for sub-standard castings.—L. H.

**H.F. Inductor Heating.** — (*Elect. Rev.*, 1946, 138, (3564), 399–403).—Equipment for heat-treatment and brazing is described.—J. C. C.

## XVIII.—HEAT-TREATMENT

**Refrigerating Aluminium to Arrest Age-Hardening.** M. L. Rask (*Modern Metals*, 1945, 1, (9), 19–21).—The purpose of refrigerating is to keep the aluminium alloy in a soft and workable condition before forming; e.g., high-strength alloys like 75S can be prevented from natural ageing. Refrigeration may be



used after the solution heat-treatment and quenching, and before the precipitation heat-treatment.—L. H.

**Heat-Treatment of Metals and Alloys.** J. W. Donaldson (*Metallurgia*, 1946, 34, (199), 25–28, 24).—In a review of the more recent developments and improvements in the industrial heat-treatment of both ferrous and non-ferrous metals and alloys, special reference is made to bright annealing and age-hardening.—J. W. D.

**Uniformity Problems in Heat-Treating.** Victor Paschkis (*Aluminum and Magnesium*, 1946, 2, (4), 12–13, 17).—A general discussion of the conditions necessary to give minimum thermal gradients for both heating and cooling during heat-treatment. The type of furnace, means of heating, and type of charge are discussed.—E. C. E.

**Theoretical Principles of the Annealing of Metals in Protective Gases.** W. Baukloh (*Gas u. Elektrowärme*, 1943, 5–8; *Chem. Zentr.*, 1943, 114, (II), 1407; *C. Abs.*, 1944, 38, 5480).—Physico-chemical principles of oxidation, carburization, decarburization, and sulphurization, and the reactions taking place in protective gases are described. Directions are given for the calculation of equilibrium diagrams.

## XIX.—WORKING

**Fabricating Aluminium Into Difficult Shapes.** — (*Modern Metals*, 1946, 2, (1), 27, 29).—Several applications are described in which aluminium is now being used, e.g., for the manufacture of a deep-drawn bomb-tube and a communications tube. The development (which is outlined) of aluminium presses during the war made many of the novel applications possible.—L. H.

**Design-Rolling or Rigidizing Light Metals.** Richard S. Smith (*Modern Metals*, 1946, 2, (1), 8–11).—Rigidizing or design-rolling is a method of form-finishing which adds stiffness and impact and buckling strength, and thereby permits the use of lighter-gauge sheet than is normal. It is shown how the cost of this process is more than offset by the saving in metal. This process is being applied in the automobile and aircraft industries, and in architecture.—L. H.

**Flexible Tools for Stamping Light Metals.** — (*Modern Metals*, 1945, 1, (7), 14–15).—L. H.

**Stamping Light Metals.** — (*Modern Metals*, 1945, 1, (3), 4–6).—The progress made in stamping aluminium and magnesium is outlined.—L. H.

**Experiences in the Working of Copper Billets Into Copper Wires.** C. Scharwächter (*Gas u. Elektrowärme*, 1943, 56–58; *Chem. Zentr.*, 1943, 114, (II), 2097; *C. Abs.*, 1944, 38, 5766).—The origin of the “hydrogen sickness” of copper as a result of the reduction of  $\text{CuO}_2$  in a reducing atmosphere is explained. Means of avoiding it are discussed, especially by the elimination of contact of red-hot copper with unburned hot gases.

**Spinning Magnesium.** Robt. J. Schneider (*Modern Metals*, 1945, 1, (2), 8–11).—The forming of magnesium by spinning as carried out in U.S.A. is described and illustrated.—L. H.

**Machining Practice for Magnesium Castings.** H. E. Linsley (*Aluminum and Magnesium*, 1945, 1, (12), 12–14, 21, 28).—The need for care in clamping magnesium castings to machine beds is pointed out. Machining is generally performed at the max. spindle speed obtainable on the machine. Surface speeds of 150–1200 ft./min. with feeds up to 0.040 in. and relatively heavy depths of cut, occasionally as deep as 0.5 in., are used. The cutting angles and design of cutting tools for milling, drilling, reaming, and tapping are discussed. Grinding, lapping, and polishing operations are also described.—E. C. E.

**The Cold Sawing of Light Alloy Bars by the Circular Saw.** Henri Poulain (*Rev. Aluminium*, 1945, (117), 175–177).—The cold sawing of Duralumin

billets is discussed from the point of view of the spacing of the saw teeth, the speed of rotation, and the rate of feed. The power consumption for sets of arbitrary conditions is calculated, and estimated cutting times are found to agree very well with those obtained experimentally.—E. C. E.

## XX.—CLEANING AND FINISHING

**Cleaning Aluminium.** C. W. Smith (*Modern Metals*, 1945, 1, (7), 16-17).—S. describes the steps necessary in the cleaning process before spot welding or paint-bond treatments.—L. H.

**Metal Cleaning. II.—Soil-Removal Performance Methods.** Jay C. Harris (*Bull. Amer. Soc. Test. Mat.*, 1945, (136), 31-39).—Cf. *ibid.*, 1945, (133), 23; *Met. Abs.*, this vol., p. 107. The direct evaluation of metal cleaners by measurement of their relative ability to remove a given soil by laboratory methods is considered. The methods covered include soak tank, mechanical tank or spray, electrolytic, solvent or vapour degreasing, and emulsion degreasing. The types of soil or foreign matter generally encountered have been classified: mineral oil blanking lubricant, cutting oils, soap emulsions used in cutting and pressing, drawing soaps, buffing compounds, graphite drawing compounds, carbonized oils or greases or food products, asphaltic or tarry materials, corrosion products, food residues and paints, varnishes, waxes, &c. In determining the effectiveness of soil removal, the "water-break" has most often been used, but methods giving numerical comparisons have recently been applied. These depend on such things as photometric reflectance measurements, ultra-violet photography for measurement of retention of oil-soluble fluorescent dye, and petroleum ether washing for the removal of retained oil.—A. B. W.

**Survey of Methods for Cleaning Metals.** J. M. Bialovsky (*Indust. Finishing*, 1944, 20, (5), 41-48).—The following processes are briefly described: solvent cleaning; alkali cleaning, usually by means of mechanical washers; removal of mill scale by pickling; and "flame-priming" with the acetylene torch.

—P. R.

**Different Processes for Cleaning Metal.** G. C. Close (*Indust. Finishing*, 1944, 20, (4), 42-46).—Recommendations for metal cleaning, and especially for that of brass and bronze, include the provision of a separate tank for each of these alloys; their phosphoric-dipping after cleaning with alkali; the use of "emulsion degreasing" before immersing metal parts in the hot cleaning solution; the electro-cleaning of steel, copper, brass, and some die-cast alloys; the steam-cleaning of plant and equipment; and phosphatizing, which both cleans and passivates a surface, and can be effected by brush application in the case of large parts.—P. R.

**Fundamentals of Finishing Magnesium.** — (*Modern Metals*, 1945, 1, (9), 26-28).—L. H.

**Cleaning, Surface Treating, and Protectively Coating That New, Lightest Metal—Magnesium.** G. C. Close (*Indust. Finishing*, 1944, 20, (9), 30, 34, 36, 38, 40, 42; (10), 38, 42, 44, 49-50, 55).—The properties of magnesium with respect to corrosion are reviewed, and an account is given of various methods of cleaning. Magnesium alloy parts are usually supplied after a chrome-pickling treatment, and the coating should be removed before fabrication; allowance should be made in design for the considerable amount of material so removed. Accounts are given of chrome-pickling, acid and alkaline dichromate treatments, anodic oxidation, and several organic finishes; bath compositions and common commercial designations are given.—P. R.

**Soap in Aluminium Finishing and Maintenance.** Georgia Leffingwell and Milton A. Lesser (*Aluminum and Magnesium*, 1945, 1, (12), 15, 21, 28, 34).—An account of the cleaning of aluminium by soap solutions and abrasive



powders containing soap. The formulæ of some cleaning powders are given.—E. C. E.

**Electrolytic Finishes on Metal Improve Corrosion-Resistance.** E. L. Cableck (*Product Eng.*, 1944, 15, 754-755; *C. Abs.*, 1945, 39, 667).—The coating becomes softer and less corrosion-resistant as its porosity increases. Anodized aluminium is superior to cadmium-plated steel in wear- and corrosion-resistance. The Ano-zinc process of zinc plating is satisfactory when a black coating is required. Where black is not required, the Iridizing treatment is successful.

## XXI.—JOINING

**The Aluminium Dip-Brazing Process.** C. L. Bensen and R. N. Weber (*Aluminum and Magnesium*, 1945, 2, (3), 14-17).—The parent aluminium alloy has a thin sheet of lower-melting-point alloy rolled on to one or both sides. When an assembly of such material is immersed in a flux bath at a temperature between the melting points of the two parts of the sheet, the lower-melting-point alloy runs and forms pressure-tight joints. Many examples of successful fabrication by the process are described and illustrated.

—E. C. E.

**Filler Metal Flow in Brazed Steel.** — (*Iron Age*, 1946, 157, (15), 60-61).—An investigation was carried out to determine the distance silver alloy filler metal will flow in steel brazing in relation to joint spacing, type of parent metal, and direction of flow.—J. H. W.

**Spraying Filler Metal on Brazed Joints.** — (*Iron Age*, 1946, 157, (13), 52-54).—The results of an investigation on the possible advantages of applying filler material for copper or silver brazing by spraying are given. A comparison of bond areas and shear strength of a sprayed filler metal joint against the usual wire filler joint showed that, although there is a small decrease in brazed joint strength and percentage bond, the use of gun-sprayed filler results in an increase in production and a saving in man-hours.—J. H. W.

**\*Substitute Solders of the 15 : 85 Tin-Lead Type.** J. B. Russell and J. O. Mack (*Trans. Amer. Inst. Min. Met. Eng.*, 1945, 161, 382-397; discussion, 397-398).—See *Met. Abs.*, 1945, 12, 64.

**Tin in Solder.** J. H. Collins (*Proc. Amer. Gas Assoc.*, 1943, 25, 354-363; *C. Abs.*, 1944, 38, 4243).—A solder containing tin 38, antimony 2, and lead 60, or tin 40 and lead 60%, is satisfactory for repairing gas meters. Solder reclaimed from meters is used by the industry.

**Substitute Solders of Low Melting Point.** M. Dannenmuller (*Mécanique*, 1943, 27, 35-39, 58; *Chem. Zentr.*, 1943, 114, (II), 367; *C. Abs.*, 1944, 38, 4557).—The following practical conclusions are drawn from phase diagrams of 2- and 3-component alloys: bismuth, cadmium, and lead are not miscible in the fused state with either aluminium or iron. Bismuth and lead are only slightly miscible with zinc. Cadmium dissolves a great deal of zinc as well as copper at low temperatures, although the  $\text{Cu}_2\text{Cd}_3$  compound formed is brittle and therefore not useful for soldering. The solubility of copper in either bismuth or lead is very slight below 350° C. These metals, therefore, only render the solder more readily fusible and do not improve its ability to adhere to copper. Copper, iron, and zinc dissolve readily in molten tin even below 350° C. Aluminium, however, does not dissolve well in molten tin at low temperatures, but, like iron and copper, dissolves well in molten zinc. The presence of impurities (more than 0.1% of copper or more than 0.05% of iron) in lead-tin solders low in tin (10-20%) is injurious. Such solders, however, may contain zinc, which can be substituted for 2-3% of the tin in 20% tin solders. Solders with 20% of tin are especially suitable for use with the soldering lamp, since those with 15% of tin give dry melts and those with

more than 33% give melts which are too mobile. Compositions of various solders and directions for using them on various metals are given.

**Tests Prove Advantages of Flame-Soldering Cable Joints.** R. C. Fitzgerald (*Elect. Light Power*, 1944, 22, (3), 70-72; *C. Abs.*, 1944, 38, 5789).—Considerable saving in solder can be effected by the use of flame soldering instead of wiped joints. Solders containing as little as 20% of tin can be used. Microscopic examination showed that one source of pinholes was an untinned or dirty area in the seal itself.

**Welding Aluminium Structures.** W. J. Conley (*Modern Metals*, 1945, 1, (3), 14-16).—A few examples of the automatic arc-welding process employed in fabricating aluminium structures, are given.—L. H.

**Welding as an Important Tool in Aluminium Fabrication.** W. J. Conley (*Aluminium and Magnesium*, 1945, 1, (11), 28-31).—The most easily welded aluminium material is commercially pure aluminium, followed by the 1.25% manganese alloy. The aluminium-magnesium-silicon alloys containing 0.5-1% of each added element are more difficult to join by fusion welding. The heat-treated alloys with copper as the main alloying element are suitable, with certain reservations, for resistance-welded designs, but the mechanical properties and corrosion-resistance are impaired by fusion-welding. The electric-arc process of welding is described, and the technique employed for various types of joint is illustrated. Special reference is made to automatic shielded carbon-arc welding.—E. C. E.

**\*Weld Cracks in Magnesium-Manganese-Cerium Alloys.** H. Mader and F. Laves (*Magnesium Rev.*, 1946, 6, (1), 28-33).—Translated from *Aluminium*, 1943, 25, (4), 157-159; see *Met. Abs.*, this vol., p. 144.

**Electrical Technique in Resistance Welding.** T. E. Calverley (*J. Inst. Elect. Eng.*, 1946, [1], 93, (62), 97-98).—C. discusses briefly the effect of current and time on the heat produced in a weld.—E. V. W.

## XXII.—INDUSTRIAL USES AND APPLICATIONS

**Aluminium Alloys and Their Structural Use.** H. K. Hardy and C. G. Watson (*Structural Eng.*, 1946, 24, (2), 65-112).—I.—*Metallurgical*. A concise account of the production of aluminium, the melting, alloying, and casting of the metal into ingots and billets, and their fabrication to semi-finished components by rolling, extrusion, and forging and subsequent heat-treatment. The further fabrication of the semi-finished products by machining, forming, and joining is described. The composition and properties of the principal aluminium alloys are given, and their resistance to corrosion and protection against it are discussed. II.—*Structural Use*. An investigation was made to determine the economic value of aluminium alloys for structural work. It was concluded that for bridging long spans and for suspension bridges aluminium would have an economic advantage; that the construction of masts and towers will not be economical on a first-cost basis; and that the special field of aluminium alloys is in mobile structures, *i.e.*, in transport.

—E. C. E.  
**Aluminium Bridges. A Gateway to Further Structural Applications.** — (*Modern Metals*, 1945, 1, (7), 18-19).—L. H.

**Bridges of Aluminium.** — (*Modern Metals*, 1945, 1, (6), 4-5).—Details of the manufacture of the U.S. Army M4 aluminium bridge are given.—L. H.

**Aluminium Alloy for Ships' Superstructures.** — (*Motor Ship*, 1946, 27, (316), 40-41).—A report on the examination of aluminium alloys, which were used in the superstructure of the M.S. *Ferriplant* to the extent of 14 tons, shows that there was virtually no corrosion in any of the alloys after four years' severe sea service. The behaviour of the alloys in the superstructure



was greatly aided by the careful caulking of joints where the aluminium contacted dissimilar metal, which in most cases was steel. The aluminium alloys examined were closely related to Alcoa alloys 52S and 53S.—J. W. D.

[The Use of Aluminium in] Naval Constructions. Arne Brinck (*Rev. Aluminium*, 1945, (117), 183–188).—For constructions of the same strength, aluminium alloys could replace mild steel with a saving in weight. This saving could be used to increase the load carried, to increase the speed, or to decrease the power required. Equations are given illustrating the last two points. The corrosion-resistance of aluminium alloys is discussed, together with the need for protection against electrolytic corrosion at the junctions between aluminium and steel. Examples of constructions in which aluminium alloys are used are given.—E. C. E.

[Use of Aluminium Alloys in] Life-Boats. Pierre de Lapeyrière (*Rev. Aluminium*, 1945, (117), 189–192).—A discussion on the use of aluminium alloys for the construction of life-boats, with a description of a French product.—E. C. E.

Light Metals in a New-Type Cruiser. Karl Brocken (*Modern Metals*, 1946, 2, (1), 17–19).—Some novel applications of light alloy, especially in the engine ventilating system and in the form of structural parts, are described.—L. H.

Aluminium for Boats. — (*Modern Metals*, 1945, 1, (10), 21).—L. H.

Two Commercial Vehicles: The Citroën P45 Truck and the Berliet G.D.M. Tanker. Jacques Valeur (*Rev. Aluminium*, 1945, (117), 178–182).—A description with technical data regarding weight and pay load of the two vehicles. Aluminium and magnesium alloys are used to reduce the unladen weight.—E. C. E.

Projected Designs for Light-Weight Automobiles. W. C. Nichols and Joseph Palma, jun. (*Modern Metals*, 1945, 1, (8), 4–7).—L. H.

Aluminium Semi-Trailer. — (*Modern Metals*, 1945, 1, (10), 18–19).—The weight of a refrigerated trailer was cut by 57% by the use of high-strength light alloys.—L. H.

Aluminium Aeroplane Hangar. — (*Modern Metals*, 1946, 2, (1), 31).—A brief outline is given of the design of an aircraft hangar which will be constructed of aluminium.—L. H.

Aluminium Alloy Scaffolding. G. O. Taylor (*Metallurgia*, 1946, 34, (199), 15–17).—The use of aluminium alloys for tubular scaffolding is discussed, with particular reference to weight, facility in erecting, and resistance to rust and scale. Details are given of a series of loading tests carried out with light alloy aluminium tubing and three different types of standard couplings—right angle, cam lock, and swivel couplings. A suitable aluminium alloy can also be used with advantage to replace clamps and couplings made from malleable iron.—J. W. D.

Aluminium Lightning Rods. — (*Modern Metals*, 1945, 1, (7), 7).—L. H.

Largest Aluminium Rotor. — (*Modern Metals*, 1946, 1, (12), 18–19).—L. H.

Aluminium Butter Churns. — (*Modern Metals*, 1945, 1, (9), 24–25).—The application of cast aluminium for butter churns is described.—L. H.

The Aluminium Salvajor. E. H. Benson (*Modern Metals*, 1946, 2, (1), 21, 23).—A machine for dish-washing in large restaurants and now made largely of aluminium, is described.—L. H.

The Aluminium Bazooka. — (*Modern Metals*, 1946, 1, (12), 12–13).—L. H.

Aluminium Clothes-Pins. — (*Modern Metals*, 1946, 2, (1), 24).—L. H.

A Designer Looks at Light Metals. George Walker (*Modern Metals*, 1945, 1, (3), 10–13).—Some novel designs in which light metals form the construction material are described and illustrated.—L. H.

**Light Metals and Personal Flying.** Frederick H. Roever (*Modern Metals*, 1945, 1, (6), 10-12).—The application of light metals in privately owned aircraft is discussed.—L. H.

**Light Metal Seating.** — (*Modern Metals*, 1946, 1, (6), 14, 15).—Novel designs of seats made from aluminium and magnesium are described and illustrated.—L. H.

**Light-Weight Stampings. Economical for Many New Products.** — (*Modern Metals*, 1945, 1, (8), 22-23).—L. H.

**Cerium.** G. Ahrens (*Modern Metals*, 1945, 1, (8), 20-21).—Some of the properties of cerium, as well as some of the present-day applications, are presented. Cerium has been used during the war as a minor alloying component with both aluminium and magnesium, and certain properties have thereby been improved in cast and in wrought parts. 37 references.—L. H.

**Working and Application of Copper-Plated Steel and Aluminium Pipes and Wires.** Edmund R. Thews (*Schleif-, Polier- u. Oberflächentechn.*, 1943, 20, 21-23; *Chem. Zentr.*, 1943, 114, (II), 2203; *C. Abs.*, 1944, 38, 5774).—Steel and aluminium pipes achieve properties through copper plating which could never be attained with solid copper pipes; they retain, however, the characteristic properties of the latter. Tensile strengths of the steels used for plating and the plating procedures are given. Fields of application for copper-plated aluminium pipes are discussed. No difficulties are encountered in the copper plating of aluminium pipes.

†**Copper Conductors for Overhead Lines.** G. W. Preston and H. G. Taylor (*J. Inst. Elect. Eng.*, 1944, [II], 91, (23), 451-463; discussion, 463-468).—A comprehensive review of the subject, dealing with conductors of hard-drawn copper (solid and hollow), cadmium-copper, reinforced copper, and copper-clad steel. Consideration is given to such aspects as (1) the creep of conductors and their initial non-elastic extension in relation to their effect on sags, (2) max. safe operating temperatures, and (3) corrosion-resistance. Details are given of developments in the application of compressed sleeve-joints.—E. V. W.

**Indium.** Wm. S. Murray (*Modern Metals*, 1945, 1, (6), 6-9).—A general outline. Properties and applications, including plating light metals with indium for surface protection, hardening, and decorative finishes, are briefly described.—L. H.

**Wrought Magnesium.** Irving T. Bennett (*Modern Metals*, 1946, 1, (12), 6-11).—Available wrought alloys, alloy additions, fabrication methods, design considerations, and applications, are described.—L. H.

**Aircraft Oil Tanks of Magnesium Alloy.** J. B. West (*Aluminum and Magnesium*, 1945, 1, (11), 16-19, 34).—A general account is given of the fabrication of magnesium alloys in sheet form to aircraft oil tanks, with special reference to forming at elevated temperatures.—E. C. E.

**Portable Magnesium Gravity Conveyors.** M. M. Moyle (*Modern Metals*, 1946, 2, (1), 12-14).—Very light portable gravity conveyors are being applied where speedy transportation of materials is essential. Construction methods, a service record, and the advantage of magnesium over steel, are discussed.—L. H.

**Thin Magnesium Strip.** H. W. Porth (*Modern Metals*, 1945, 1, (9), 13-15).—P. deals with the properties, fabrication, joining, and uses of "Thinstrip." Thin-gauge magnesium has been used advantageously for specific war-time purposes, and it is expected that it will now find use for instruments parts such as pointers, damping vanes, and moving condenser plates.—L. H.

**Magnesium Canoes.** M. M. Moyle (*Modern Metals*, 1945, 1, (9), 16-18).—M. gives some service records of magnesium canoes which have been in use for 10 years. The methods employed in manufacturing a canoe are described.—L. H.



**Magnesium in Portable Tools.** M. M. Moyle (*Modern Metals*, 1945, 1, (8), 14-16).—L. H.

**Magnesium in Textile Equipment.** M. M. Moyle (*Modern Metals*, 1945, 1, (7), 4-6).—L. H.

**Opportunities for Magnesium in the Petroleum Industry.** — (*Modern Metals*, 1945, 1, (6), 13).—A few of the possibilities for magnesium products offered by the petroleum industry are outlined.—L. H.

**Magnesium To-Day.** Thur Schmidt (*Modern Metals*, 1945, 1, (9), 4-6).—S. deals with some war-time magnesium applications and discusses several advantages and disadvantages of magnesium.—L. H.

**Rhodium.** C. C. Downie (*Min. Mag.*, 1944, 71, 265-269; *C. Abs.*, 1945, 39, 483).—Rhodium withstands corrosive influences, including that of *aqua regia*. Although high in price per unit weight, it is relatively inexpensive as a plating agent on account of the exceedingly thin deposit possible. D. discusses development, applications, and recovery.

**Silver for Electrical Purposes.** R. A. Collacott (*Elect. Times*, 1944, 105, 42-44; *Elect. Eng. Abs.*, 1944, 47, 44).—C. discusses the application of silver to current-carrying contacts, commutators, and slip-rings. The addition of 0.05% of silver reduces the corrosion of lead alloys containing 4 to 12% of antimony used in accumulators. The use of silver in the electroplating industry is discussed.

**Use of Zinc Alloys as Substitute Materials for Other Metals and Alloys.** A. Portevin, — Patin, — Wagner, and — Grunberg (*Usine*, 1942, 51, (9), 31-33).

**Zinc Alloys for Die-Casting Purposes.** H. Patin (*Métaux, Corrosion-Usure*, 1942, 17, 139-151; *Chem. Zentr.*, 1943, 114, (I), 1814; *C. Abs.*, 1944, 38, 3935).—Improving the purity of the zinc metal to 99.993% resulted in an essential improvement of the zinc alloys. Zamak 2, 3, 5, and 6 are discussed as regards composition, chemical and physical behaviour, ageing, conditions for working, and possibilities for use.

**The Metallurgy of the Jeep.** Roger F. Mather (*Metallurgia*, 1946, 32, (198), 283-286; 33, (199), 9-14).—In a description of the metallurgy of the jeep, materials *versus* design is first considered and attention given to testing and to various material specifications. In dealing with the ferrous and non-ferrous alloys, used for the more important parts, reference is made to an aluminium alloy piston, tin-base and lead-base bearing metals, leaded bronze and sintered bronze containing 10% tin for bushings, and bronze for thrust washers. Surface treatments include the tinning of the aluminium piston and of some of the piston rings. Copper was deposited on the cam of the steering gear.—J. W. D.

**Babbitt Bearing Metals Developed During War-Time.** T. E. Eagen (*Power Plant Eng.*, 1944, 48, (11), 81-83; *C. Abs.*, 1945, 39, 483).—Owing to the war-time 12% limit for tin, various problems have arisen and these are discussed. The discussion covers cleaning, casting, bonding, and thickness of Babbitt.

**Modern Bearing Materials.** Fritz Wehrmann (*Gas- u. Wasserfach*, 1943, 86, 420-421; *C. Abs.*, 1944, 38, 3940).—In Germany only thin shells of copper alloys could be used in bearings, fused on to the backing metal. Entire bearings can be made of zinc or lead alloys, but even these must be used economically. The chief defect of synthetic resin bearings is their poor heat conductivity, leading to carbonization, &c.; in some cases this can be avoided by using thin layers or by special water-cooling means. Cast-iron bearings are suitable for special purposes, and have been improved. Ball and roller bearings, when usable in permitted sizes, are very economical and save lubricating oils. Sintered iron bearings offer promise, but require special machining methods, and like the cast-iron bearings are rather brittle under conditions of recurring shock.

**Innovations in Gas-Using Appliances in Budapest.** Josef Beczkóy (*Gas-u. Wasserfach*, 1943, 86, 353-357; *C. Abs.*, 1944, 38, 3453).—The outer jackets and draught breakers on water heaters are often of aluminium, lacquered or polished. Consideration must be given to the avoidance of galvanic corrosion on parts in contact with water; so that the same material must be used throughout, or all parts given the same metallic coating. Lacquer coatings can be used to a limited extent, but are apt to be somewhat porous. Insulating joints are of value in limiting corrosion of dissimilar metals, especially in gas and water meters. In water pipes, connection of aluminium to brass causes rapid corrosion of the aluminium. Hard aluminium alloys must be used for parts which have to be threaded. Stuffing boxes are best made of rustless steel, and a special design is illustrated. Luminous water-heater burners gave trouble owing to enlargement of the orifices. Better results were secured with a Bunsen-type burner with the orifice away from the combustion zone; the burner itself was constructed of aluminium. Pilot burners are made of steatite in three sizes for 12, 16, and 20 litres/hr., and these have proved relatively free from stoppages formerly encountered. For water-heater construction, steel is satisfactory only for continuous service; otherwise condensate formation causes rapid corrosion. When condensation is avoided, steel corrodes less than copper. The low thermal conductivity of iron and its alloys is also a disadvantage. One successful water heater was made from pure aluminium. Aluminium is frequently used in range construction. Gas-cocks are often of zinc or aluminium, sometimes with cast-iron plugs, but these metals require lubrication with a mixture of cylinder oil and paraffin to avoid "freezing." Brief reference is made to radiant space heaters.

**The Development of Tin-Free Containers for Foods.** H. Ketterl (*Metallwirtschaft*, 1943, 22, (33/35), 493-496; *C. Abs.*, 1944, 38, 4889).—The saving of tin in making food containers has been accomplished by (1) making tinplate electrolytically instead of by dipping; (2) tinning only the inside of containers, and using an aluminium-lacquer on the outside; (3) employing black iron (plate) instead of the customary tinned iron; (4) use of lacquered ware—at first of poor quality, but later much improved; (5) use of folded containers; (6) use of metal protected from corrosion; and (7) aluminium containers. The advantages and suitability of each type for specific foods are discussed.

### XXIII.—MISCELLANEOUS

**Quartz Crystal Plating.** H. G. Wehe (*Bell Lab. Record*, 1945, 23, (12), 475-479).—A description is given of the vacuum evaporation of metals on to quartz plates for use in radio and telephone equipment.—E. V. W.

**\*Distribution of Tensile Load in Relation to Temperature and Sag of Steel-Cored Aluminium Conductors.** E. W. W. Double (*J. Inst. Elect. Eng.*, 1945, [II], 92, (28), 349-361; discussion, 361-364).—D. concludes that the final load distribution is determined by the rate of creep in the aluminium wires and is independent of the stringing temperature. It is shown that inelastic stretch of a conductor can cause large increases in sag which far outweigh those that might result from creep, and since inelastic stretch is mostly removed when the conductor is tensioned up to the max. design load, prestressing is recommended before final stringing of the conductors.—E. V. W.

**The Application of Sound in Metallurgy.** V. Bekker (*Novosti Tekhn.*, 1941, (4), 25-26).—[In Russian.] A sound vibrator used to obtain a uniform distribution of lead in aluminium and zinc alloys, is described. It is possible by this method to introduce 10% of lead into aluminium and 7% of lead into zinc.—N. A.

**\*The Action of Metals and Metal Salts on the Vitamin C Content of Milk.** G. Reif (*Milchwirtschaftl. Forsch.*, 1941, 21, 1-9; *Chem. Zentr.*, 1941, 112, (II 1340; *C. Abs.*, 1944, 38, 1803).—The effect of metal chlorides and of



sheet aluminium on the vitamin C content of milk was investigated. Aluminium, magnesium, and titanium were found to be indifferent, while tin, zinc, nickel, manganese, iron, and copper reduced the vitamin content, the effect of the last two ions being most pronounced. Acids inhibited the destruction of the vitamin, while alkalis promoted the action. With metal salts, the effect of the metal was found to be dependent on that of the acid constituent. The salts of indifferent metals were either without effect or the acid residue had only slight effect in preventing the destruction of the vitamin. With metals having a more or less vigorous destructive action on vitamin C, the salts of the metals also reduced the vitamin content, so that in this case the effect of the metal portion of the salt was stronger than that of the acid residue. Salts of nickel, zinc, and tin repressed the destruction of the vitamin; with these salts, therefore, the influence of the acid residue predominates over that of the metal to a greater extent than in the case of the salts of aluminium, magnesium, and titanium. The salts of copper, iron, and manganese were still effective in 0.01% solution; salts of the other metals were no longer effective at this concentration. The presence of slight amounts of other metals in aluminium alloys was without effect. On the other hand, the manner of treatment of the sheet metal did have a certain effect. Bright surfaces had no effect while the effect of oxidized surfaces varied with the manner of production of the oxidized coating. Sheets of metal which had already been used showed no further effect.

**\*Beryllium Poisoning.** H. S. Van Ordstrand, Robert Hughes, J. M. DeNardi, and Morris G. Carmody (*J. Amer. Med. Assoc.*, 1945, 129, 1084–1090; *C. Abs.*, 1946, 40, 968).—Various beryllium compounds are toxic. In the group studied the highest incidence of disease was found in workers employed in the sulphating and in the oxyfluoride processes. Prophylaxis consisting of safety clothing, masks, and proper ventilation, proved most effective.

**The Biophysical or Biochemical Remote Action of Metals and the Prospect for the Application of the "Atomoligodynamism" of Metals.** A. Bertuzzi (*Chim. Ind. Agric. Biol. Realizzaz. Corp.*, 1942, 18, 12–32; *Chem. Zentr.*, 1942, 113, (II), 2309; *C. Abs.*, 1944, 38, 2860).—If certain metals, such as lead, cadmium, and mercury, are brought within a distance of 2–90 mm. of schizomycetes, eumycetes, protozoa, coelenterata, or platelminthes by means of the air, the biological subject quickly dies. The cause of death is not a radiation, but an accumulated, diffusible, air-borne gas which consists of vapour which the metals give off at ordinary temperature. The metals have at ordinary temperature a vapour pressure calculable by extrapolation. The metals with higher vapour pressure are more active than those with lower vapour pressure. The biological remote action on the subject is the same as that of a very dil. solution of the corresponding metal salt (cation effect). The effect of the metals is reduced if the pH of the culture liquid lies in the neighbourhood of the isoelectric point of the subject. The negative electric charge of bacteria in water is reduced by the remote action of the metals. B. denotes the described remote action of the metals as "atomoligodynamic" effect to differentiate it from the oligodynamic effect, which he defines as "ionoligodynamic effect." B. proposes investigating the remote action of metals for the control of peronospora.

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