METALLURGICAL ABSTRACTS

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(GENERAL AND NON-FERROUS)

I.—PROPERTIES OF METALS

*The Place of Yttrium and the Application of Ferricyanide Precipitation in the Rare-Earth Group. The Purification of Erbium. Joseph K. Marsh (*J. Chem. Soc.*, **1947**, (Jan.), 118–122).—The position of yttrium (atomic number 39) is discussed in relation to its atomic and ionic radii. On the former, yttrium interpolates between the rare-earth elements neodymium (atomic number 60) and samarium (atomic number 62), and on the latter between holmium (atomic number 67) and dysprosium (atomic number 66). This provides a method of eliminating and purifying yttrium. By means of ferricyanide precipitation, yttrium may be separated from holmium and erbium. The reduction of yttrium in erbium from 7 to 0·32 at.-% was accomplished by six precipitations with 50% yield. Erbium may be purified by ferricyanide precipitation and hydrolysis. Six precipitations of 93% erbium gave a 50% yield of 99·7 at.-% material.—D. P. M.

Titanium—Some Properties and Applications. H. W. Greenwood (*Metallurgia*, 1947, **36**, (211), 44).—The properties of titanium and some of its alloys are briefly summarized. Applications in non-ferrous metallurgy include age-hardening copper and nickel alloys and grain-refining light-metal alloys.

—M. A. V.

*Contamination and Failure of Rare-Metal Thermocouples. (Manterfield). See p. 28.

Relations Between the Elastic Constants. D. S. McGregor (*Engineering*, 1947, **164**, (4252), 76).—A method is described of deriving the relation between the modulus of elasticity, the modulus of rigidity, and Poisson's ratio for a material. The method is claimed to be simple and to avoid the approximation difficulty associated with another method based on the distortion of a square section of a piece of a material. The method is derived from the facts that equal complementary shear stresses exist on planes at right angles, and that on planes at 45° to the pure shear planes there are mutually perpendicular pure tensile and compressive stresses, each of magnitude equal to the pure shear stress.—R. GR.

*On the Surface Optical Anisotropy of Striated Reflecting Surfaces. Jacques Farran (*Compt. rend.*, 1947, **224**, (15), 1103–1105).—The surface anisotropy of reflecting surfaces scratched by a fine abrasive has already been described and explained by Capdecomme (*Bull. Soc. franç. Minéral.*, 1940, **63**, 57–63). F. has continued this study to determine if abrasion gives rise to definite, reproducible, optical phenomena, capable of being related to the physical constants. Aluminium, copper, cadmium, and V_2A steel specimens were first electrolytically polished, a chromium specimen being given a simple mechanical polish. The pressure exerted had little effect on the anisotropy. Apart from copper, with a difference of up to 15 or 20%, all the metals gave concordant values for anisotropy, within about 2%. The anisotropy increased with the grain-size of the abrasive, tending, for the plastic metals, to an asymptotic value with large grains, as follows : aluminium 2·05, cadmium 1·9, copper 1·7, V_2A steel 1·55 ; chromium has a lower value and behaves somewhat differently. The optical significance of these results is discussed.—J. H. W.

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

B

†**Electrons and Metals. I.—The Nature of an Atom. II.—The Nature of a Metal. III.—The Nature of an Alloy.** William Hume-Rothery (*Metal Ind.*, 1946, **68**, (4), 70–72; (5), 89–91; (6), 109–110; (7), 129–132; (8), 149–151; (9), 169–170; (10), 189–191; (11), 209–212; (12), 229–232; (13), 249–251; (14), 269–272; (15), 289–292; (16), 309–311; (17), 329–332; (18), 349–350; (19), 369–370; 1946, **69**, (9), 178–180; (10), 199–202; (11), 217–219; (12), 241–245; (13), 259–262; (14), 283–287; (15), 305–307; (16), 325–328; (17), 343–346; (18), 367–372; (19), 387–391; (20), 409–412; (21), 427–431; (22), 451–455; (23), 471–475; (24), 491–496; 1947, **70**, (6), 107–110; (7), 131–133; (8/9/10), 149–152; (11), 167–170; (12), 187–191; (13), 209–212; (14), 229–234; (15), 249–252; (23), 421–422; (24), 441–443; (25), 459–463; (26), 481–483). An interpretation of the present state of knowledge, designed for the older metallurgist.—W. G. A.

Energy Dissipated by Foucault Currents in a Thin Ferromagnetic Disc Normal to the Field. Gustav Ribaud (*Compt. rend.*, 1946, **222**, (13), 726–727). —In a previous note (*Compt. rend.*, 1943, **216**, 377), R. discusses the case of a thin disc heated by induction in an alternating field normal to its plane. For a sufficiently high frequency, the current is confined to a layer of thickness $\varepsilon' = \sqrt{\dfrac{\rho}{2\pi\mu\omega}}$, in the vicinity of the two plane faces of the disc. For a ferromagnetic disc, the magnetic charges on its faces produce a uniform demagnetizing field which must be added to the field due to the Foucault currents. The energy W' dissipated by induction in the disc is shown to be $W' = H^2_{\text{eff.}} \cdot \dfrac{\rho r^2}{8\pi\varepsilon'} \cdot \dfrac{1}{(1 + \mu \cdot \varepsilon'/r)^2}$, and its ratio to the energy W dissipated in a disc of the same resistance but non-magnetic is $\dfrac{W'}{W} = \dfrac{\sqrt{\mu}}{(1 + \varepsilon/r \cdot \sqrt{\mu})^2}$, where ε is the thickness of the current layer. This factor, the magnetic factor, has a max. value of $r/4\varepsilon$, when $\mu = r^2/\varepsilon^2$, and tends to zero for large values of μ. The equations are not valid unless the thickness of the disc is greater than 2 or 3 times the layer thickness ε'.—D. P. M.

On the Exchange Interaction of the Valence and Inner Electrons in Ferromagnetic (Transition) Metals. S. V. Vonsovsky (*Zhur. Eksper. i Teoret. Fiziki*, 1946, **16**, (11), 981–989).—[In Russian]. For English version, see *J. Physics* (*U.S.S.R.*), 1946, **10**, 468–475; *Met. Abs.*, 1947, **14**, 362.—N. A.

***The Dependence of the Magnetostriction of Nickel Upon Initial Magnetic Texture and Sequence of Applying Magnetic Field and Unidirectional Elastic Tension.** Ya. S. Shur and A. S. Khokhlov (*Zhur. Eksper. i Teoret. Fiziki*, 1946, **16**, (11), 1011–1020).—[In Russian]. For English version, see *J. Physics* (*U.S.S.R.*), 1947, **11**, (1), 77–84; *Met. Abs.*, 1947, **14**, 356.—N. A.

The Law of Variation of Surface Tension with Temperature. Eddy Mezger (*Compt. rend.*, 1946, **222**, (16), 948–950).—Developing the internal energy, U, of a liquid molecule in a series $U = U_0 + \alpha T + \beta T^2 + \gamma T^3 + \ldots$, and integrating Helmholtz's formula $\dfrac{A}{T} = -\int \dfrac{U}{T^2} \cdot dT + \text{constant}$, where A is the free energy, M. finds that $\gamma s = A = U_0 - \beta T^2$, where γ is the surface tension and s the surface area occupied by a molecule on the surface of a liquid. If $v =$ volume of a gram-molecule and $N =$ Avogadro's Number, $s = v^{2/3}/N^{2/3}$, if the molecules have the same distribution at the surface as in the interior, but if a different distribution be assumed, $s = \dfrac{(v^{1/3} - l)^2}{N^{2/3}}$. Hence $\gamma = \dfrac{(U_0 - \beta T^2)N^{2/3}}{(v^{1/3} - l)^2}$. At the critical temp., $\gamma = 0$ and $\beta = U_0/T_c^2$, and by applying the formula at two different temp., $l = \dfrac{v_1^{1/3} - Bv_2^{1/3}}{1 - B}$, where

$B = \sqrt{\dfrac{T_c^{\,2} - T_1^{\,2}}{T_c^{\,2} - T_2^{\,2}}} \cdot \dfrac{\gamma_2}{\gamma_1}.$ Application of the formula to various substances gave satisfactory agreement, and a table of results for water and benzene is given. A correction due to the presence of gaseous molecules above the liquid surface is quoted.—D. P. M.

II.—PROPERTIES OF ALLOYS

Residual Stresses in Aluminium Alloys. R. M. Brick (*Aluminum and Magnesium*, 1947, **3**, (4), 6–7, 24).—A general descriptive account of residual stresses arising from quenching and mechanical working; stress relief is briefly considered.—F. A. F.

A Comparison Between the French " Alpax " and the German " Silumin " (13% Silicon and 0·3–0·5% Magnesium). —— (*Rev. Aluminium*, 1947, (**130**), 68).—The alloy can be obtained (1) by mixing aluminium (99·5%) and silicon (98–99%); (2) by electrolysis, adding quartz or silicon to the usual bath (French process); (3) by mixing aluminium and an alloy of silicon obtained by reducing quartz with carbon (German process). In the French process, iron is eliminated by cobalt, which is to be preferred to manganese.—M. E.

*Influence of the Crystallization of Constituents Out of Solid Solution, and of Impurities, on the Forgeability of Light Alloys. Paul Bastien (*Métaux et Corrosion*, 1946, **21**, (252/253), 105–119).—The pressure necessary for plastic flow can be estimated by static bending tests. The solid solution magnesium–6% aluminium flows under a higher pressure than pure magnesium. This is also the case for aluminium–copper and aluminium–magnesium alloys and, according to Kurnakow, is a general property with metals and alloys. When the percentage of the added metal is higher than the limit of solid solubility, the forgeability depends on the precipitated constituent : on its form (globular or acicular), its distribution, and probably its own forgeability. Aluminium–copper and magnesium–copper alloys can be forged easily in the $\mathrm{Al} + \mathrm{Al_2Cu}$ and $\mathrm{Mg} + \mathrm{Mg_2Cu}$ regions of the equilibrium diagram, and with difficulty in the $\mathrm{Al} + \mathrm{Al_3Mg_2}$ and $\mathrm{Mg} + \mathrm{Mg_3Al_2}$ regions. Even aluminium–6·5% silicon and aluminium–13% silicon alloys are difficult to forge, owing to the precipitated crystals of the eutectic.—M. E.

Notch Effects in High-Strength Aluminium Alloys. L. Schapiro (*Iron Age*, 1947, **159**, (24), 52–54).—An abstract of several papers by S. and *H. E. North, C. H. Stevenson, D. L. Moseley, O. A. Wheelon*, and *S. J. Barrett*, prepared by S. The relative notch sensitivity of the aluminium alloys 14S-T, 24S-T, and 75S-T was evaluated on the assumption that the pressure of a notch changes the ultimate-strength and limiting-strain characteristics of the material. The effect of holes in large structural members was also investigated. The validity of the equation : $\log (1 - x)S_u/S_n = -Nx$ was tested, S_n being the notched ultimate strength, S_u the un-notched ultimate strength, x the fraction of the original area removed by the notch, and N the index of stress–notch sensitivity, being zero for an ideal notch-insensitive material.—J. H. W.

A Better Duralumin—Ageing Slowly, for Rivets. Yves Bresson (*Rev. Aluminium*, 1946, (**128**), 384–390).—Duralumin used for rivets must age slowly. Research has been carried out on the influence of its three addition elements on the rate of ageing. Copper and silicon increase the rate of ageing; magnesium has little influence on the rate, but increases the ultimate stress after ageing. The best alloy contains copper 2, silicon 0·15, and magnesium 0·6%; its tensile characteristics are : yield point 16·5, ultimate stress 33, and shear stress 1 kg./mm.².—M. E.

*On the Optical Anisotropy of the Silicides of Iron, Manganese, and Nickel. Théophile Cambon (*Compt. rend.*, 1947, **224**, (15), 1112–1114).—C. describes the metallographic and molecular structures obtained and the optical anisotropy observed with solid solutions and compounds of iron, manganese, and nickel with silicon.—J. H. W.

*Lead-Base Babbitt Alloys. I.—Physical and Corrosion Properties. II.— Fatigue and Wear Properties. Henry P. George (*Product Eng.*, 1947, **18**, (5), 118–121 ; (6), 138–141).—(I.—) Ten lead-base alloys were tested and compared with a tin-base alloy (antimony 7·5, copper 3·5%, tin balance) used as a reference. The composition of the lead alloys varied from 0·75–11 tin, 8–15 antimony, 0·2–2 copper, and 0·2–3% arsenic, the balance being lead. Typical microstructures of the alloys show a duplex structure with hard intermetallic compounds and softer phases, except for a straight lead–tin alloy (tin 3·5%). A comprehensive table gives some of the most important physical properties, and it appears that the liquidus temp. of the lead alloys is generally lower than that of the reference tin alloy, while the solidus temp. is higher. There is no significant difference in the coeff. of friction, and no significant change in weight or visible evidence of corrosion was noted in any of the alloys after immersion at 300° F. (150° C.) for 6 weeks in unagitated oil. Several of the lead-base alloys are softer at room temp. than the tin-base reference alloy, although at 250° F. (122° C.) the difference tends to disappear. Other properties such as yield strength, ultimate compressive strength, dynamic compression, distortion of Babbitt lining under impact, creep under compression, and rate of contraction under creep compressive tests are tabulated. (II.—) The load-carrying ability, as bearings, of the lead-base alloys were determined in a rotational wear test. Loads were applied to the bushing in increasing increments through a collar by a calibrated helical spring. Each increment of load was carried for 24 hr. before the next increase was made. Under this test, none of the lead-base alloys supported as much load as the tin-base reference alloy. All the lead-base alloys showed better resistance to the development of cracks than the tin-base reference alloy. Wear-fatigue tests were performed in a device that simulated in accelerated form the conditions that lead to failure of automotive bearings. The specimens were placed in a centrifugal bearing fatigue-testing machine, in which a rotating load simulated the loading of a main bearing. In the majority of the runs, the rod (upper) bearing was damaged more than the rod cap (lower bearing), and in some instances small areas were surrounded completely by fatigue cracks.—H. V.

*Magnesium Alloys : [Effect of] Small Calcium Additions. Marvin E. Gantz (*Amer. Foundryman*, 1947, **11**, (3), 33–38).—G. reports that when calcium is employed in contents of 0·1–0·2%, the hot-rolling characteristics of such alloys as AZ31X and M1 are improved to such a degree that it is possible to conduct the direct rolling of sheet from sheet ingots. In addition, the mechanical properties of the sheet are enhanced. Microporosity in castings in such alloys as AZ92 and AZ63 is reduced by the addition of 0·5% of calcium. This calcium content also decreases the time required for satisfactory solution treatment, and eliminates the necessity for preheating cycles in the solution treatment of castings of the magnesium–aluminium–zinc type. Calcium additions reduce the oxidation rate of molten alloys, possibly by virtue of the formation of a partially protective film on the exposed surface of the molten alloy. The incidence of hot cracks in fine-grained castings in certain magnesium alloys (e.g. AZ92) is reduced by calcium additions. One of the most serious objections to the use of calcium additions is its apparent tendency to form skins in castings. This defect, however, may be partially overcome by modification of the method of gating, so as to reduce turbulence.—J. E. G.

Magnesium : Wrought Alloys. G. Fitzgerald-Lee (*Machine Shop Mag.*, 1947, **8**, (6), 93–96).—A summary of the mechanical properties of magnesium

alloys in general and of the Elektron and Magnuminium series in particular. Nothing novel is disclosed.—H. V.

Ni-Span [Nickel–Iron–Titanium Alloys]. W. A. Mudge and A. M. Talbot (*Iron Age*, 1946, **157**, (17), 66–70).—The authors describe the properties of 5 new nickel–iron–titanium alloys of the Invar type, which are age-hardened after cold working to 35–50% reduction. The alloys may be divided into 3 groups : (1) low-expansion alloys : Ni-Span " Lo42 " (nickel 41·5, titanium 2·4%), Ni-Span " Lo45 " (nickel 45·5, titanium 2·4%), and Ni-Span " Lo52 " (nickel 52, titanium 2·4%); (2) a high-expansivity alloy : Ni-Span " Hi " (nickel 29, titanium 2·4, chromium 8·5%); and (3) a const.-modulus alloy : Ni-Span " C " (nickel 42, titanium 2·4, chromium 5·4%). All the alloys contain about 2% of the minor additions and impurities carbon, manganese, silicon, aluminium, phosphorus, and sulphur, the balance being iron. The influence of the alloying elements on the basic iron–nickel system and on the mechanical properties of the alloys is discussed in some detail. By compound formation, carbon neutralizes four times its weight of titanium, while titanium neutralizes more than twice its weight of nickel. Increase of titanium content lowers the temp. at which the inflection in the coeff. of expansion/temp. curve occurs in the " Lo " alloys, and moves the thermo-elastic coeff. towards a negative value in the " C " alloy. A similar effect is produced by chromium, but the response to ageing is lowered and the rate of work-hardening increased. Full details are given of the recommended heat-treatments. Softening is accomplished by heating at 1700°–1850° F. (926°–1010° C.) for 20–90 min., and hardening by heating at 1100°–1350° F. (593°–732° C.) for 3–24 hr.; forging and hot rolling are carried out at 2100°–2200° F. (1149°–1204° C.), with a finishing temp. of 1600°–1800° F. (871°–982° C.) to refine the grain. The alloys are capable of developing ultimate strengths of up to 200,000 lb./in.². The elastic moduli vary between $21–27 \times 10^6$ lb./in.². The " Lo " and " C " alloys are ferromagnetic at room temp., while the austenitic " Hi " alloy is non-magnetic at all temp. Some information is given with regard to corrosion-resistance.—R. W. R.

*On the Crystals of the Amalgam of Polonium and Silver. (Mlle.) Catherine Chamié (*Compt. rend.*, 1947, **224**, (18), 1282–1283).—When mercury that has absorbed polonium, by contact with an acid solution of polonium, is turned out on the gelatine of a photographic plate, the polonium gives star-like images in discontinuous groups, the points of the star representing the dispositions of the α-particles in the gelatine. To explain how the polonium ions produce these photographic impressions, C. made experiments : (1) on the diffusion of the polonium across the mercury, (2) on the fixation of the polonium on the gelatine, (3) on the activation of the mercury by the polonium disposed on the silver, and (4) in an examination of the polonium–silver amalgam. She concluded that : (1) with mercury the polonium forms an amalgam that can separate itself from the mercury in (probably crystalline) grains, and (2) for large amounts of polonium these radio-active grains can serve as centres of crystallization for the silver amalgam ; without silver these crystals are never obtained.—J. H. W.

The Effect of Crystal (Piezo-Electric) Vibrations at Radio and Higher Frequencies on Metals (Primarily Steel). E. S. Elliott (*J. Record Trans. Junior Inst. Eng.*, 1945–46, **56**, 131–136).—E. describes apparatus for the production of high-frequency mechanical vibrations by using the piezo-electric properties of quartz, and suggests possible lines of research into the effect of such vibrations during the melting, welding, or nitriding of steel.—H. J. A.

*The Fatigue Strength of Some Tin–Antimony–Copper and Other Tin-Base Alloys. P. G. Forrester, L. T. Greenfield, and R. Duckett (*Metallurgia*, 1947, **36**, (213), 113–117).—A range of commercially used tin-base alloys was fatigue tested in rotating cantilever machines at 100° C., and test data are presented in tabular form. In general, increasing antimony and copper in

tin–antimony–copper alloys led to increased fatigue strength, and antimony in solid solution and copper in eutectic were more effective than either element in the form of massive compounds. An alloy containing antimony 7 and copper 1% showed a fatigue-strength maximum, thought to correspond to a ternary peritectic complex. Continuous stressing of tin–antimony alloys led to a fine precipitate of SbSn. Casting conditions had little effect on the fatigue strength of tin–antimony–copper alloys. Fatigue strengths of some alloys could be increased by additions of 1% bismuth or 0·1% tellurium.

—M. A. V.

*An Investigation of the Embrittlement of Platinum–Rhodium Wire in the Heads of Liquid-Steel Pyrometers. (Land). See p. 26.

*Fracture of Platinum and Platinum–13% Rhodium Wires Used in the Immersion Thermocouple. (Reeve and Howard). See p. 27.

*Embrittlement of Platinum/Platinum–Rhodium Thermocouples. (Chaston, Edwards, and Lever). See p. 28.

*High-Temperature Alloys [for Use in Gas Turbines]. H. J. Grant (*Iron Age*, 1946, **157**, (21), 42–48; (22), 50–56; (23), 77–80; (25), 60–63).—A summary of research carried out at the Massachusetts Institute of Technology on high-temperature, high-strength alloys for use in gas turbines. The alloys investigated were : (1) 37 low-carbon forging alloys of the nickel–chromium–cobalt–iron and nickel–chromium–iron types, (2) 80 casting alloys of similar composition but with higher carbon contents, and (3) 37 cast alloys of the Vitallium type (approx. cobalt 69, chromium 23, and molybdenum 6%). Creep tests were carried out on all these alloys at 1500° and 1600° F. (816° and 871° C.), and in some instances room-temp. tensile tests were performed. A metallographic and X-ray study was made of the effect of heat-treatment on the alloys, and the effect of such treatment on rupture life and ductility was investigated. Tests of the forgeability of alloys in group (1) were made, and the effect of variations of mould temp. in the casting of the alloys of groups (2) and (3) was studied. The effect of added elements (nitrogen, tantalum, zirconium, and tungsten) was also investigated. The optimum carbon content for the cast nickel–chromium–cobalt–iron alloys lay in the range 1·00–1·20%. High-temperature strength was increased by the addition of carbon in all instances, but with the nickel–chromium–cobalt–iron alloys was accompanied by loss of ductility ; no such loss occurred with the cobalt–chromium–molybdenum materials. At 1500° F. (816° C.), the best alloy of the cast nickel–chromium–cobalt–iron type contained carbon 1, nickel 30, chromium 20, cobalt 21, molybdenum 3, tantalum 2·0, and tungsten 2·2%, and broke after 109·5 hr. (30,000 lb./in.² load). This material had a life of 542·4 hr. at 25,000 lb./in.² load. At the same temp., a similar alloy containing 1·21% carbon, and with 1% columbium replacing the tantalum, gave the extremely low creep rate of 0·00001% per hr. (15,000 lb./in.² load). Of the Vitallium alloys, one containing 2% tantalum showed the best properties, having a life at 1500° F. (816° C.) of 297·3 hr. under 30,000 lb./in.² load ; its creep properties were, however, inferior to the best of the nickel–chromium–cobalt–iron group, a creep rate of 0·000034% per hr. (13,500 lb./in.²) being found. At 1600° F. (871° C.), this alloy gave a life of 122·2 hr. at 25,000 lb./in.² ; while a nickel–chromium–cobalt–iron alloy (carbon 1·02, tantalum 2·0%) had a life of 148 hr. under the same stress. The best heat-treatment for the cast nickel–chromium–cobalt–iron alloys is 2260° F. (1238° C.) followed by water quenching. In general, a nickel content of 30% was better than one of 20%, and tantalum is more effective than columbium. The presence of nitrogen was also beneficial. Polishing the test specimens considerably increased their strength. The optimum mould temp. for the cast alloys was about 1850° F. (1010° C.).—R. W. R.

Creep and Some Creep-Resisting Alloys. G. Burns (*Papers on Engineering Subjects* (a restricted Admiralty publication), 1946, (**22**); also (abridged) *Metallurgia*, 1947, **36**, (212), 63–65; and *Mech. World*, 1947, **122**, (3155), 17–19).—A brief review of the present-day conception of creep. The creep characteristics of typical alloys are discussed, reference being made to the non-ferrous nickel–chromium alloys (Nimonics).—J. E. G.

*On the State of Equilibrium of Solid Solutions.** Pierre Laurent (*Compt. rend.*, 1947, **224**, (20), 1431–1433).—Studies of the mechanism of precipitation in supersaturated solid solutions show that this results from the superposition of these two processes : (1) collection of the atoms in excess in certain regions without alteration of the crystalline system (maturation), and (2) transformation of these regions with alteration of the crystalline system (actual precipitation). L. studied the conditions of stability of the heterogeneous solid solutions resulting from maturation from a mathematical point of view. He concluded that below a certain temp. a homogeneous solid solution is not stable, and that the degree of heterogeneity increases when the temp. diminishes.—J. H. W.

The Fundamentals of Metallurgy. Kenneth G. Keeling (*Assoc. Eng. Ship Draughtsmen* [*Publ.*], **1946–47**, 31 pp.).—The significance and determination of metallurgical equilibrium diagrams are described. The composition, heat-treatment, and mechanical properties of some plain carbon- and alloy steels are recorded, and the fields of application of some copper-, aluminium-, magnesium-, and tin-base alloys are briefly reviewed.—H. J. A.

Present Trends in Alloys. —— (*Canad. Metals*, 1947, **10**, (3), 25–26).— A brief review of some modern alloys, particularly triple alloy steels containing controlled amounts of nickel, chromium, and molybdenum ; stainless steels ; cast bronzes ; high-nickel irons ; and high-nickel alloys of the Monel and Inconel type.—H. J. A.

Strength and Ductility. Maxwell Gensamer (*Engineer*, 1947, **183**, (4754), 195 ; and *Iron Age*, 1946, **157**, (7), 66–70).—See *Met. Abs.*, 1946, **13**, 314.
—W. G. A.

III.—STRUCTURE

(Metallography ; Macrography ; Crystal Structure.)

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

*Notes on the Macrographic Study of Aluminium and Its Alloys.** J. Hérenguel and F. Santini (*Rev. Mét.*, 1946, **43**, (5/6), 132–136).—There are two types of macrographic technique ; one reveals the grain boundaries and the other the relative orientation of the grains. In the technique suggested, impurities and heterogeneity are revealed. Samples are immersed in a hot solution of hydrochloric acid (10–30%) for 10–40 sec. By this method, the authors have studied the distribution of impurities in ingots cooled at different rates. Except when high corrosion-resistance is required, it is best to cool quickly in order to obtain the most complete dispersion of the constituents.—M. E.

Increasing the Reflectance of Metals [Aluminium] with Multiple Films. A. F. Turner (*J. Opt. Soc. Amer.*, 1946, **36**, (12), 711).—A summary of a paper on the application to metal reflectors of a process similar to the " blooming " of lenses, but with opposite effect. The reflectivity of a polished aluminium surface can be increased from 91 to 96% by a pair of surface films, one of MgF_2 and one of ZnS. A second pair of similar films improves the factor to 98%. The improvement, which is valid for a wide range of wave-lengths of reflected light, is in contrast to the reflection-reducing effect on glass.
—E. van S.

Phenomenon of Bronze in Surface Coatings. G. L. Buc, R. H. Kienle, L. A. Melsheimer, and E. I. Stearns (*Indust. and Eng. Chem.*, 1947, **39**, (2), 147–154).—Read before the American Chemical Society. " Bronze " is defined as the appearance of colour which originates in selective reflection at one interface, or interference of white light reflected at closely adjacent structures. These two types are known as " interface bronze " and " interference bronze ". For the latter, the colour varies widely with varying angle of view, but is fairly const. for the former. Methods of measuring bronze and some of the unusual colours exhibited are described, and a theoretical calculation predicts the general shape of the spectrophotometric curve of interface bronze.—D. P. M.

*On the Examination by Electronic Diffraction of Surfaces Obtained by **Electrolytic Polishing [Iron, Aluminium, Copper].** Jean Jacques Trillat (*Compt. rend.*, 1947, **224**, (15), 1102–1103).—T. examined, by electronic diffraction, specimens of pure iron, aluminium, and copper, electrolytically polished in either a perchloric–acetic bath (iron and aluminium) or a phosphoric bath (all). Electrolytic polishing causes the Beilby layer to disappear more or less completely, according to the duration of the operation. The subjacent metal re-appears with its particular structure, as well as any oxides that arise. The nature of the bath appears to be of importance in the case of the readily oxidizable aluminium. Heterogeneity of structure appears to be the general rule.—J. H. W.

*An X-Ray Investigation of the Embrittlement of Platinum and Platinum–Rhodium Wires. (Goldschmidt and Land). See p. 27.

*Examination of the Microstructure of Contaminated and Embrittled **Platinum and Platinum–Rhodium Wires.** (Jewell). See p. 28.

An Accelerated Method of Electrolytic Polishing. L. Chamagne, H. Granjon, and A. Leroy (*Métaux et Corrosion*, 1946, **21**, (250), 73–80).—With the usual polishing method, using Jacquet's electrolyte, polishing does not begin until the potential reaches the required level of the potential–intensity curve. This results in a loss of time. In the new process, the sample is introduced into the electrolyte with the potential already at the required level, thereby reducing the time of polishing from 8 min. to 15 sec.—M. E.

Metallography for the Electroplater. (Blazy and Mohler). See p. 17.

Structure of Metallic Surfaces. J. Liger (*Galvano*, 1947, **16**, (124), 7–9).—An elementary survey.—M. E.

The Control and the Study of Surfaces with an Electron Microscope. Maurice Deribéré (*Machines et Métaux*, 1947, **31**, (344), 125–128).—M. E.

Summarized Proceedings of Conference on the Electron Microscope, Oxford, 1946. (Cosslett). See p. 23.

*Phase Microscopy with Vertical Illumination. Helen Jupnik, Harold Osterberg, and G. E. Pride (*J. Opt. Soc. Amer.*, 1946, **36**, (12), 710).—A summary of a pioneer paper on the application of phase-contrast microscopy to metal surfaces, which must be highly polished. The vertical illuminator is modified by the addition of an annular diaphragm, which is imaged on a diffraction plate near the objective. Depressions of the surface of the order of a fraction of a wave-length of light in thickness, or transparent surface films of similar thickness, cause local retardations of the light waves, which are visible in the field of the diffraction plate and sometimes have better visibility than could be produced by any other method of illumination.—E. VAN S.

*X-Ray Spectra with Monochromatic Radiation. Adolphe-Jean Rose (*Compt. rend.*, 1946, **222**, (14), 805–806).—R. describes the use of strictly monochromatic radiation with a Debye–Scherrer camera to obtain very fine spectrum lines, free from diffuseness due to the continuous background. The monochromator consists of a piece of quartz bent to a radius of curvature of

600 mm., which focuses the $K\alpha_1$ and $K\alpha_2$ rays on the camera entrance, a slit of calcite isolating the $K\alpha_1$ beam. It is claimed that exposure times are not notably increased. The method of measurement of the films is described and corrections are applied for eccentricity of the camera, vertical divergence of the beam, height of the beam, size of specimen, and for refraction. Experimental values are given for a copper specimen, the extrapolated value of the parameter at $21°$ C. being $3\cdot6073 \pm 0\cdot0003$ Å.—D. P. M.

V.—POWDER METALLURGY

Powder Metallurgy : Advantages of Self-Lubricating Bearings Made by Powder Metallurgy. M. T. Victor (*Canad. Metals*, 1947, **10**, (4), 18–21, 38).— The theory of porous self-lubricating bearings is discussed, and their design is considered in terms of (1) the metallurgy of manufacture, and (2) the type of oil with which the bearings are impregnated. The selection of lubricants, corrosive action of certain oils, and failure of porous bearings are briefly discussed.—H. J. A.

***Metallurgy of Powders—Study of Sintered Kovar.** Nguyen Thienchi (*Compt. rend.*, 1946, **222**, (18), 1046–1047).—Preliminary results are given on the preparation and properties of Kovar (nickel 29, cobalt 17, iron 54%, no manganese). The pure metals were obtained by reduction of the oxides, and the powders (nickel and iron 200 sieve, cobalt 300) moulded at 3 tons/cm.^{2}. Sintering was carried out in hydrogen, three samples being prepared : (1) in a resistance furnace at $1050°$ C. for 10 hr., density 6, (2) at $1050°$ C. for 20 hr., density $6\cdot5$, (3) by induction heating at $1250°$ C. for 1 hr., density $7\cdot8$. The density of solid Kovar is $8\cdot3$. All three samples sealed perfectly to the same glass, with no blisters. Debye–Scherrer photographs are shown.—D. P. M.

***Preparation of Titanium Powder.** R. K. Hanna and H. W. Worner (*J. Council Sci. Indust. Research, Australia*, 1946, **19**, (4), 449–454).—Several methods of preparing titanium were critically studied with a view to selecting one for producing, in Australia, the titanium needed in compound gettering mixtures. The method selected was a modification of one developed by Kroll, and consisted in the reduction of titanium tetrachloride with magnesium at $800°$–$900°$ C. The product, containing not less than 98% titanium, proved satisfactory as a constituent of certain gettering mixtures.—H. J. A.

The Static Hazard in [the Metallic Powder] Industry. George Morris (*Engineering*, 1947, **164**, (4251), 49–51 ; (4252), 73–75).—M. reviews the conditions necessary for the generation of electrostatic charges in various industries, including the metallic powder industry, and suggests methods of test for dangerous conditions. The gold-leaf electroscope is quite unreliable for testing conditions. Metallic dust clouds are much more inflammable than clouds of organic dusts. Dow metal, iron dust, and magnesium powders can be ignited with less than $0\cdot1$ joule.—R. GR.

VI.—CORROSION AND RELATED PHENOMENA

***Contact-Corrosion Problems in the [Aluminium] Metal-Window Industry : An Assessment of Their Relative Importance.** E. F. Pellowe and F. F. Pollak (*Metallurgia*, 1947, **36**, (212), 67–70).—Cast aluminium alloy window frames may be in contact with steel, galvanized steel, brass, pure aluminium, or stainless steel, and experiments were carried out to determine the effect of the couples so set up on corrosion. The pairs of metals were immersed for 1 month in 3% NaCl solution, followed by 1 month in tap water ($pH = 8\cdot0$). Each system was studied in the painted and unpainted form. Results were in

agreement with the A.S.T.M. 3-year natural corrosion test. Corrosion of aluminium in contact with bare steel was unexpectedly heavy, due possibly to the effect of iron corrosion products. The stoved paint film was more effective than had been expected. In the case of the aluminium–zinc couple, the aluminium was protected by the zinc, and the zinc corrosion not unduly high. Aluminium in contact with brass showed pitting, especially in the contact area.
—M. A. V.

†The Causes and Prevention of Stress Corrosion in Brass. J. C. Chaston (*Sheet Metal Ind.*, 1947, **24**, (243), 1395–1401, 1404).—C. discusses the present state of knowledge of season cracking. Low-temperature annealing to relieve stress is only satisfactory if the brass is not subsequently stressed beyond the yield point. Too much reliance cannot be placed on the mercurous nitrate test, since service failures may occur at stress levels at which mercury will not cause cracking. Ammonia cracking occurs at very much lower stresses. C. considers that the provision of a brass of suitable composition which will be free from season cracking is the best solution of the problem ; the addition of certain elements, particularly silicon, having shown the possibilities of this method.—R. Gr.

Corrosion-Resistance of Spot-Welded Aluminium Assemblies [in Salt Water]. Nicolas Beliaeff (*Rev. Aluminium*, 1946, (**129**), 3–9).—A welded joint is not attacked more vigorously at the weld than elsewhere. The French alloy " Duralinox " gives the best corrosion-resistance. Anodizing, and metallizing with pure aluminium, increase corrosion-resistance. Tempering spot-welded Duralumin improves the tensile properties of the joints, but lowers resistance to corrosion.—M. E.

The Use of Glass Wool for Thermal Insulation of Apparatus in Light Alloys. Jean Hérenguel (*Rev. Aluminium*, 1946, (**129**), 10–11).—Hot water or steam passing through glass wool becomes alkaline and attacks the aluminium. However, wool made of scorias can be used because it is only very slightly alkaline.—M. E.

*Lead-Base Babbitt Alloys. I.—Physical and Corrosion Properties. II.—Fatigue and Wear Properties. (George). See p. 4.

*Internal Oxidation. F. N. Rhines (*Corrosion and Material Protection*, 1947, **4**, (2), 15–20).—A review of the present state of knowledge of internal oxidation or sub-scale formation. The mechanism of the process is discussed, and the role of diffusion stressed. The importance of the manner of nucleation of the oxide in determining the structure of the sub-scale is pointed out, and is shown to depend on the temp. of reaction and the nature and concentration of the alloying element. The rate of advance of the oxidation is controlled by the diffusion rate of oxygen in the metal and of the reacting element. There is no evidence that the precipitated oxides cause a hardening effect similar to age-hardening, but they do appear to influence recrystallization and grain growth. The text is well illustrated with photomicrographs, and 14 literature references are given.—G. T. C.

Is there Poison in Your Corrosion-Resisting Alloy ? D. E. Jack (*Corrosion and Material Protection*, 1947, **4**, (2), 12).—J. discusses in general terms the possibility of traces of copper dissolved from various corrosion-resisting alloys being sufficient to cause serious contamination of liquids coming in contact with the alloys.—G. T. C.

Industrial Handling of Fluorine. Ralph Landau and R. Rosen (*Indust. and Eng. Chem.*, 1947, **39**, (3), 281–288).—The unusual physical, chemical, corrosive, and physiological properties of fluorine are summarized, and its comparative heats of reaction and its effect on various metals and non-metallic substances tabulated. A schematic flow diagram used to study the latter at various pressures is shown. Dilute and pure fluorine have substantially different properties, while nickel, Monel metal, aluminium, magnesium, and

metal fluorides in their highest valence states have excellent corrosion properties. Unexplained inhibited reactions sometimes occur. Standard or extra-strong iron pipes for atmospheric, and nickel and Monel-metal pipes for greater pressures are recommended for conveying, using welded joints. Flanged joints, with soft copper, aluminium, or Teflon (tetrafluoroethylene) gaskets may be used for low pressures, while valves with Teflon as seating element and Monel metal or nickel as mating element are recommended, welded or silver- (not soft-) soldered into the line. Instruments, compressors, &c., must be selected with great care. Storage, which is hazardous, requires thick Monel-metal or nickel containers. Safety precautions, an efficient treatment for burns, and successful disposal methods are described. Fireproof neoprene is a successful protective fabric.—D. P. M.

The Prevention of Corrosion by Fluorine and by Hydrofluoric Acid Requires Quite Special Apparatus. Mars G. Fontana (*Indust. and Eng. Chem.*, 1947, **39**, (3), 91A–92A).—A brief summary of the corrosive properties of fluorine and hydrofluoric acid, and materials suitable for handling them.—D. P. M.

Corrosion. Mars G. Fontana (*Indust. and Eng. Chem.*, 1947, **39**, (4), 81A–82A).—On the basis of the appearance of corroded metal, corrosion is classified arbitrarily into eight forms : uniform attack or general corrosion, intergranular corrosion, galvanic or two-metal corrosion, erosion-corrosion, dezincification, pitting, stress corrosion, and concentration-cell corrosion. A brief summary, with examples, of the first two is given.—D. P. M.

Studies on Corrosion in Great Britain and the U.S.A. During the War (1940–1945). E. Herzog (*Métaux et Corrosion*, 1946, **21**, (251), 92–100).— H. summarizes papers by U. R. Evans and G. D. Bengough, on theories of corrosion and protection, read at the conference of the Centre de la Lutte Contre la Corrosion in Paris in April 1946.—M. E.

Corrosion Inhibitors. —— (*Metallurgia*, 1946, **34**, (203), 270–273).—A report of a symposium on " Inhibitors for Control of Scale and Corrosion in Water " held at a joint session of the Division of Industrial and Engineering Chemistry and of Water, Sewage, and Sanitation Chemistry of the American Chemical Society.—W. G. A.

VII.—PROTECTION

(Other than by Electrodeposition.)

Corrosion Protection Lengthens Life of Aluminium Transportation Units. J. F. Mason (*Aluminum and Magnesium*, 1947, **3**, (5), 14–15, 17, 21).—A general discussion of the corrosion of aluminium alloys used in the transport industry and of the types of finishes and paints which may best be used to protect them. The use of zinc chromate is considered.—F. A. F.

Metallization with Aluminium. C. R. Draper (*Light Metals*, 1947, **10**, (110), 124–160 ; correspondence, (112), 254).—A lengthy discussion of current techniques and apparatus for the coating of metallic and non-metallic articles with aluminium. Mechanical, dipping, and calorizing methods are dealt with, and spraying methods are described at length ; uses of sprayed coats are also discussed. Corrosion findings are considered, as well as resistance to high-temp. oxidation. The use of aluminium in paint, electrodeposition, evaporation, and sputtering is then reviewed, together with its application to mirrors.
—F. A. F.

Surface Preparation for Metal Spraying [Zinc and Aluminium]. —— *Machinist* (*Eur. Edn.*), 1947, **91**, (8), 235–238).—The necessity for proper surface preparation to secure adhesion in metal spraying, the metallurgical considerations involved, and the methods of preparation that can be used are

described. The metals primarily concerned are zinc and aluminium; cadmium has somewhat limited applications on account of its high cost.

—J. H. W.

Shipbuilding at Home and Abroad [Use of Sprayed Zinc Coatings]. ——— (*Syren and Shipping*, 1947, **202**, (2639), 480).—In the U.S., widespread use is made of sprayed zinc coatings on the welds of ships' plating and on a variety of auxiliary parts. The method of applying the zinc coating is by means of the Schori metal-powder pistol and the Schori metallizing process. The adhesion between paint and galvanized iron is poor, and once a repainted film reaches any appreciable thickness the stresses of cold and heat cause it to blister and peel off. Paint adheres well to sprayed zinc, regardless of the thickness of the film, and, although the zinc spraying costs more initially, the total cost over a period of 10–20 years is substantially less.—H. V.

Equipment for Hot Galvanizing. A. Gordet (*Galvano*, 1947, **16**, (121), 18–19).—General advice is given on equipment to be used.—M. E.

The Term " Deoxidation " in Hot Galvanizing. A. Gordet (*Galvano*, 1947, **16**, (124), 17–19).—Answers to letters received by G.—M. E.

Theory of the Anodic Oxidation of Aluminium in a Bath of Sulphuric [Acid].—I, —II, —III, —IV. J. Glayman (*Galvano*, 1947, **16**, (121), 13–17; (122), 13–17; (123), 12–14; (124), 13–16).—(I.—) A discussion of the application of Nernst's Law in the anodizing process. (II.—) The best potential for anodizing is 50 V., and the potential at the electrodes increases according to the logarithm of the c.d. Colloidal additions lower the surface tension. Aluminium sulphate increases the resistance, but the addition of nitric acid gives aluminium nitrate, which decreases the resistance of the solution. Copper sulphate impedes the anodizing process, but if tartaric acid is added a complex copper ion is formed which is not harmful. (III.—) The colour of the hydroxide is a function of its concentration. If colloidal impurities are present in the bath, the intensity of the colour is diminished. (IV.—) The colour of the hydroxide is also due to adsorption. Fixing is effected by the polymerization of the alumina after dehydration of the hydroxide.—M. E.

Grey- or Black-Coloured Anodic Films on Industrial Aluminium–Magnesium Alloys. J. Hérenguel and R. Segond (*Métaux et Corrosion*, 1946, **21**, (252/253), 101–104).—This effect is generally due to silicon, precipitating out of solid solution. The solubility of silicon decreases with increasing percentage of magnesium. Incomplete oxidation of the silicon causes a precipitation of Al_3Mg_2, which gives the same result. Tempering at 450° C. prevents this precipitation. It is advisable to use pure metals for making the alloys and to cool the ingots quickly.—M. E.

The Dichromate Treatment for Magnesium. ——— (*Products Finishing*, 1947, **11**, (7), 96, 98).—A brief outline of a dichromate treatment for magnesium prior to painting. Operating details are given.—G. T. C.

Anodizing of Magnesium Alloys for Protection and Appearance. George Black (*Product Eng.*, 1947, **18**, (5), 122–124).—The process produces a protective and decorative magnesium oxide–silicate film on the alloys of magnesium. The coating is applied in a strong alkaline solution at elevated temp. (180° F. (88° C.)) at 4–6 V. The decorative properties can be further enhanced by dyeing to almost any colour desired. The type, thickness, and shape of the material being treated, and the desired end product, determine whether A.C. or D.C. should be used. In general, the A.C. process is best for narrow-gauge wrought alloys and the D.C. for heavier gauges, castings, and intricate shapes. The coating and bath characteristics for A.C. are : light- to dark-grey colour, 20–30 amp./ft.², good throwing power, 0·0002–0·0005 in. thickness, and extremely dense and compact film. The D.C. characteristics are : light-green colour, 10–20 amp./ft.², excellent throwing power, 0·0004–0·001 in.

thickness, and some porosity noticeable at 250 magnifications. The cycle of operations is as follows : degrease, alkaline cleaner, water rinse, water rinse, acid cleaner, water rinse, anodize, water rinse, water rinse, neutralizer.

—H. V.

Finishes for Magnesium. R. T. Wood (*Aluminum and Magnesium,* 1947, **3,** (4), 12–14, 17, 22).—An address to the Magnesium Association. A general review of the subject, covering surface preparation and cleaning, treatments used as preparation for painting (including anodic methods), paint systems, and chemical coatings.—F. A. F.

Aluminium-Coated Steel May Offer Advantages for Many Products. ——— (*Products Finishing,* 1947, **11,** (5), 58, 60, 62).—Aluminium-coated steel is now being produced by a hot-dipping process by the American Rolling Mill Co. The finish is soft and satiny, but a brighter " extra-smooth " grade is also available. The weight of coating is 0·50 oz./ft.² on both sides, equivalent to a thickness of 0·001 in. per side. The material withstands up to 2000 hr. in 20% salt spray at 95° F. (35° C.). It shows no discoloration below about 900° F. (482° C.), and no destructive scaling below about 1600° F. (871° C.). Tests have been carried out on car exhaust pipes, domestic-range oven liners, circulating boiler parts, &c. When the sheet is to be painted, surfaces should be " mill-bonderized ", which is carried out at the works before despatch.

—G. T. C.

*Ten Years' Outdoor Exposure of Filled Asphalt Coatings on Saturated Felts. G. L. Oliensis (*Bull. Amer. Soc. Test. Mat.,* 1947, (**144**), 32–41 ; discussion, 41–48).—Past exposure tests on filled coatings have been made on small rigid aluminium panels for relatively short periods under artificially produced weathering conditions. These tests have indicated that nearly all fillers improve the weatherability of asphalt. In the present paper, O. presents test data for asphalts coated on asphalt-saturated felt. The specimens were exposed out of doors for approx. 10 years, and the results indicate that fillers do stabilize the flow and thereby improve the life of roofing cements which have a relatively low softening point ; but fillers do not improve the crack resistance of coatings which have a high softening point and which do not flow when unfilled.—H. J. A.

VIII.— ELECTRODEPOSITION

*Plating on Aluminium. R. A. Ehrhardt and J. M. Guthrie (*Monthly Rev. Amer. Electroplaters' Soc.,* 1947, **34,** (4), 421–428).—E. and G. discuss commercial applications of plating on aluminium, and review early developments. They describe in detail a soldering test for the adhesion of electroplate to aluminium and its alloys. Two specimens, $1 \times \frac{1}{16} \times \frac{1}{8}$ in., are soldered end to end in a suitable jig, using 50 : 50 lead–tin solder. They are then pulled in a tensile machine. After breaking, an attempt is made to resolder in order to determine if the break has occurred in the solder or at the bond between the plate and the aluminium. Four materials were tested : commercial-purity aluminium ; aluminium with 4·5% copper and 1·25% magnesium ; aluminium with 5·0% silicon ; and aluminium with 2·5% magnesium and 0·25% chromium. Zincate solutions were used as a pretreatment, and the optimum conditions established in each case by means of the adhesion test described. These were : sp. gr. 1·38–1·41, copper content 3–7 g./l., zinc content 65–78 g./l. The composition was most critical with the alloy containing chromium. A hydrofluoric acid dip was used in the case of the silicon-containing alloy. The optimum time of immersion in this was found to be 15–45 sec.—G. T. C.

Improved Barrel-Plating Technique [Cadmium Plating]. Herberth E. Head (*Metal Finishing,* 1947, **45,** (3), 55–57).—In order to avoid the necessity of

removing work from barrels to baskets and *vice versa* during the various stages of the cadmium-plating cycle, a cylindrical barrel was designed in which cleaning, rinsing, acid dipping, and plating were carried out in succession without removing the work. The cylinder material was melamine–canvas laminate. There was negligible contamination of solutions due to drag-out, and the materials used in the construction withstood the conditions well. A 50% increase in production is claimed.—G. T. C.

Practical Advice on Chromium-Plating Baths. —— (*Galvano*, 1947, **16**, (121), 10–11 ; (122), 7–8).—If iron impurities are present in the bath, it is necessary to add sulphuric acid. When this is present in excess, gas is evolved ; too little acid results in brown spots on the plating.—M. E.

Copper Plating in Alkane Sulphonic Acid Baths. C. L. Faust, B. Agruss, E. L. Combs, and Wayne A. Proell (*Monthly Rev. Amer. Electroplaters' Soc.*, 1947, **34**, (5), 541–549).—A description of the deposition of copper at c.d. of from 60 to 1000 amp./ft.^{2} from baths based on a new class of strong acids, viz. the alkane sulphonic acids of methane, ethane, propane, and butane. The plate obtained is semi-bright without the addition of brightening agents to the bath. Bright nickel directly over this gives a plating of good colour. The effect of varying the operating conditions for four different plating baths is discussed. These are : a dilute bath operating at about 60 amp./ft.^{2}, a similar bath at 200 amp./ft.^{2}, a bath giving a semi-bright plate with a lustre, operating at 150 amp./ft.^{2}, and one operating at 1000 amp./ft.^{2} with simple agitation. The work has not been applied on a commercial scale.—G. T. C.

Maintenance of a Bath [for Copper Plating] by Correct Additions. E. Baret (*Galvano*, 1947, **16**, (121), 11–12).—The cyanide concentration must be kept const., and addition should be made in the form of solutions, not in the solid state.—M. E.

Effect of Small Amounts of Zinc in Watts-Type Nickel Depositing Solutions. G. E. Gardam (*J. Electrodepositors' Tech. Soc.*, 1947, **22**, 8–13).—G. discusses various aspects of the presence of small quantities of zinc in a Watts-type bath, and gives quantitative data. The effect of addition of amounts of zinc up to 0·40 g./l. on the Brinell hardness of the coating is given for two solution compositions. There is in both cases an initial decrease in hardness, believed to be due to the " ageing " of the solution, followed by an increase. The effect on the appearance of the coating obtained by varying the pH of the solution between 1·8 and 6·3 and with a zinc content of 0·25 g./l., is given. The cathode potential was not found to vary significantly with variations in zinc content. The proportion of zinc in the coating was found to be much higher than in the solution. Results are given briefly of tests on eight methods of removing zinc from the solution. Only one, electrolysis at 10 amp./hr./l. at 15 amp./ft.^{2} over 20 hr., was entirely successful.—G. T. C.

Note on the Effect of Copper on Nickel Deposition. G. E. Gardam (*J. Electrodepositors' Tech. Soc.*, 1947, **22**, 14).—A dilute solution of copper sulphate was allowed to drip at various rates into an air-agitated Watts solution while electrolysis was being carried out with a nickel-foil cathode. The rate of addition at which " growthy " deposits formed on the cathode was found to correspond with a content of 0·13–0·17% of copper in anodes.

—G. T. C.

Tin Plating and Control of Tin Solution by Anode Colour. John Franklin Daymude (*Products Finishing*, 1947, **11**, (6), 42–44, 46, 48, 50, 52, 54, 56).— Solutions for still, automatic, and barrel plating of tin are described, applicable to a wide range of base metals and having excellent throwing power. The method of making up the solution is given, and control of its operation by visual observation is described, primarily for the layman without a technical education. There are sections dealing with cleaners, filtering, simple analysis, and replating on tinplate.—G. T. C.

Fusing of Electrodeposited Tin Coatings. J. Falk (*Metal Finishing*, 1947, **45**, (4), 63–65, 71).—A detailed description of a simplified method of fusing tin coatings to improve their appearance and corrosion-resistance. The fusing medium may be either hydrogenated oil, tallow, or petroleum product with a flash point above 500° F. (260° C.). The container is an electrically heated steel tank. Temp. control is important, the optimum range being 475°–490° F. (246°–254° C.). An exhaust system is essential to remove oil fumes. Time of immersion is 3–10 sec., and may be controlled visually. For small parts, a basket is used to immerse them in the oil. To prevent small parts fusing together they are placed in a breaker immediately after removal from the bath. This rotates at 200–300 r.p.m., and prevents sticking of the parts together. Trichlorethylene is used as a quench and a degreaser.

—G. T. C.

Manufacture of Zinc-Base Alloy Die-Castings. J. C. Fox (*Monthly Rev. Amer. Electroplaters' Soc.*, 1947, **34**, (3), 288–297).—The first of three papers (the other two are abstracted below) of a symposium on the plating of zinc-base alloy die-castings held at the Annual Educational Session of the Detroit Branch of the American Electroplaters' Society. F. outlines briefly the development and composition of the alloys used, and discusses casting practice, casting machines, dies, die steels, the importance of design, &c.—G. T. C.

Plating on Zinc-Base Alloy Die-Castings, Including Buffing, Cleaning, Stripping. C. F. Nixon (*Monthly Rev. Amer. Electroplaters' Soc.*, 1947, **34**, (3), 298–309).—N. describes the plating of zinc-base alloy die-castings at the Fisher Body–Ternstedt division of the General Motors Corporation. Details of degreasing, cleaning, the copper " strike " solution, and the plating solutions are given. The use of a bright copper or nickel solution followed by chromium plating is advocated as a means of reducing buffing costs. Stripping of composite copper–nickel coatings is carried out in 50–55% H_2SO_4, which is rapid and does not attack the zinc alloy excessively. No addition agent is used. The bath operates at 150° F. (66° C.) and with a voltage of 9 V. Several good photographs are given, illustrating such defects in die-castings as chills, swirls, cold laps, splashing, gate holes, and " soldering ", and their effects on subsequent plating.—G. T. C.

*Testing of Plated Coatings on Zinc-Base Alloy Die-Castings. E. A. Anderson (*Monthly Rev. Amer. Electroplaters' Soc.*, 1947, **34**, (3), 313–318).—A. describes the study of plated zinc-base alloy parts taken from cars after five years in service. Corrosion was judged visually, thickness by microscopic measurement, which A. considers inadequate, and adhesion by testing with a sharp knife. The data obtained are plotted on a graph. The importance of ensuring good adhesion of the deposited metal to the zinc alloy is stressed. Some failures of the plating are ascribed to intercrystalline corrosion of the alloy itself, resulting in an expansion, with consequent rupture of the plating. Chemical analysis confirmed unsuitable composition of the alloys in some cases. Several photomicrographs are given of failed coatings.—G. T. C.

Electroplating Zinc-Base Die-Castings. C. F. Nixon (*Metal Finishing*, 1947, **45**, (3), 58–60).—A general review of polishing, buffing, cleaning, plating, and stripping of zinc-base die-castings. The influence of casting technique on subsequent plating is mentioned. 50–55% H_2SO_4 is recommended for stripping nickel and copper plate from die-castings. The process is an electrolytic one, operated at 150° F. (66° C.) and with a voltage of 9 V.

—G. T. C.

*Bright Zinc Plating Using a Cyanide Bath Containing Sodium Sulphide. Marcel Ballay and Pierre Vogt (*Métaux et Corrosion*, 1946, **21**, (251), 89–91).—The brightness is not due to the elimination of the heavy metals by precipitation as sulphides, but to the formation of a colloidal suspension by the action of the sodium sulphide. The best electrolyte tested was : zinc 45 g./l. ($Zn(CN)_2$),

NaCN 110 g./l., NaOH 70 g./l., and 20 c.c. of a solution of sodium sulphide (100 g./l.).—M. E.

Porosity of Electrodeposited Metals (A.E.S. Research Project No. 6). I.— Bibliography. II.—Critical Literature Review. N. Thon and E. J. Addison, Jr. (*Monthly Rev. Amer. Electroplaters' Soc.*, 1947, **34**, (4), 445–453 ; (5), 568–576).—(I.—) The *bibliography* covers the period from 1887 to early 1946. It contains 226 references, mostly to published work, but a few to unpublished private communications. It represents the preliminary step in the work of A.E.S. Research Project No. 6, and is confined to sources which make explicit contributions to the specific study of the nature and causes of the porosity which seems to be a systematic occurrence in metal electrodeposits. (II.—) A preliminary part of A.E.S. Research Project No. 6, preparatory to experimental and laboratory work. The early history of the problem of porosity in electrodeposited coatings is given briefly. This is followed by a discussion of the ferroxyl test.—G. T. C.

Conductivity of Electrolytic Baths. J. Liger (*Galvano*, 1947, **16**, (121), 8–10). —A general survey of the conductivity of ions.—M. E.

Anodes and Electrolytes. E. Baret (*Galvano*, 1947, **16**, (123), 11).— Elementary advice about copper-plating baths.—M. E.

*****Determination of Free Sodium Hydroxide and Sodium Carbonate in Plating Solutions.** Louis Silverman (*Metal Finishing*, 1947, **45**, (4), 72–73).—S. describes a volumetric method in which, to obtain the sodium hydroxide content of the solution, the carbonate is precipitated with barium chloride and any cyanide present is prevented from hydrolysing by the addition of excess alcohol. A direct titration with HCl gives the NaOH content. The carbonate content is obtained by precipitating the carbonate from a second sample, filtering it off, and titrating.—G. T. C.

*****A New Time-of-Gassing Test of Thickness of Cadmium Coatings, Particularly for Small Parts.** S. G. Clarke and J. F. Andrew (*J. Electrodepositors' Tech. Soc.*, 1947, **22**, 1–7).—The solution used is 10% nickel sulphate crystals in hydrochloric acid (sp. gr. 1·16) ; with it the rates of solution of cadium coatings formed in different types of plating bath differ from each other by a comparatively small amount. The test is carried out by immersing the degreased part in the solution and noting the time with a stop watch from the commencement of gassing until there is a rapid falling off of the rate of gassing. A temp. correction of 2% of the apparent thickness for each 1° C. above or below 20° C. is added or subtracted. Curves are given for converting gassing times to thickness of coating. The accuracy of the method is considered to be within ±25%. The method is applicable to cadmium coatings on steel and copper, and probably on brass, though this was not tested.—G. T. C.

*****Apparatus for Anodically Stripping Electrodeposits from One Side of a Sheet for Analytical Purposes.** J. W. Price (*J. Electrodepositors' Tech. Soc.*, 1947, **22**, 22–23).—Owing to the difficulty of finding a stopping-off compound that would resist hot caustic soda–cyanide solution used in stripping speculum, an apparatus was devised of alkali-resistant plastic which allowed electrolytic stripping to be carried out on one side only of a plate sheet specimen. The circular specimen was placed in a threaded recess of its own dia. in a plastic block. A rubber ring gasket was placed on top, and a plastic cylinder screwed down tightly. Contact was made with the back of the specimen by means of a terminal screw. The cylinder was filled with stripping solution and a tin foil anode was suspended in it. The solution was heated by immersion of the apparatus in water near its boiling point.—G. T. C.

*****Methods of Analysis of Chromium-Plating Solutions.** (Salt).

*****Analysis of Gold and Gold Alloy [Plating] Solutions.** (Parker).

*****Estimation of Nickel, Cobalt, Chloride, Formate, and Formaldehyde in Nickel–Cobalt Plating Solutions.** (Salt).

Determination of Impurities in Electroplating Solutions. (A.E.S. Research Project No. 2.) V.—**Manganese in Nickel-Plating Baths.** VI.—Traces of Copper in Nickel-Plating Baths. (Serfass and Levine). See p. 19.

Metallography for the Electroplater. Alex Blazy and J. B. Mohler (*Metal Finishing*, 1947, **45**, (4), 54–57).—A general review of metallographic techniques for examining electrodeposited coatings. Types of microscope for low- and high-power examination, and methods of mounting, polishing, and lighting are discussed.—G. T. C.

The Significance of Polarization in Electroplating. H. Bandes (*Metal Finishing*, 1946, **44**, (12), 516–521).—A talk given before the Newark Branch of the American Electroplaters' Society.—W. G. A.

Control Apparatus for the Production of Uniform Electrodeposits from a Rectified A.C. Supply. D. Ashby and S. Wernick (*Monthly Rev. Amer. Electroplaters' Soc.*, 1947, **34**, (1), 42–49).—A. and W. discuss the difficulty of obtaining electrodeposits of uniform thickness. The minimum thickness required is usually specified, and any metal deposited in excess of this is uneconomical. Correct choice of solution, anode arrangement, and c.d. are important. An electrical unit is described which applies and maintains the predetermined current and rectifies fluctuations that occur. It also cuts off the current at the end of the plating cycle. In this way, the deposition of more metal than is required is guarded against, and substantial economies are achieved. The machine is most suitable for automatic and semi-automatic plants. During loading of the work, it can be arranged to provide a polarizing current for work already in the bath. Similarly, it can be arranged to give an initial high-c.d. " strike ", prior to the main plating operation. A stand-by power supply (large-capacity battery) is also incorporated.—G. T. C.

Rectifiers for Electroplating.—II. Louis W. Reinken (*Metal Finishing*, 1947, **45**, (4), 58–62).—R. discusses variable auto-transformers, their advantages and disadvantages, and rectifier construction. In connection with the latter, the importance of ventilation is particularly stressed.—G. T. C.

Automatic Conveyor for Electroplating. Adolph Bregman (*Iron Age*, 1947, **159**, (25), 68–74 ; (26), 58–64).—B. reviews the development, advantages, and limitations of automatic plating equipment, describes the principal types of machines suitable, and indicates where each part may be most effectively used. He gives detailed descriptions of the operating characteristics of a number of aut matic conveyors available for plating work, and discusses their costs.

—J. H. W.

Electroplating at Flint's A.C. Spark Plug Division. Bryant W. Pocock. (*Products Finishing*, 1947, **11**, (5), 30–32, 34, 36, 38, 40, 42, 44, 46).—A description of a large-scale plating equipment. Operating details are given of cleaning procedure, bright zinc plating with automatic plant, zinc barrel plating, and deposition of copper, nickel, and chromium on zinc-base die-castings.—G. T. C.

Disposal of Cyanide Wastes. John G. Dobson (*Metal Finishing*, 1947, **45**, (3), 68–71).—The use of chlorine to destroy cyanide in waste waters is discussed. The exact chemistry of the process is not fully understood, but it is suggested that the end-products of the reaction are ammonium carbonate, nitrogen, and nitrous oxide. Factors to be considered in designing a chlorination plant are discussed. The relative merits of continuous, automatically controlled, and intermittent types of treatment are mentioned. The process is apparently very successful, as in no operating plant has any failure occurred.—G. T. C.

Los Angeles Plating-Plant Explosion. Fred A. Herr (*Metal Finishing*, 1947, **45**, (3), 72–73, 107).—A serious explosion in a plating plant was ascribed to a vat of 900 gal. of perchloric acid–acetic anhydride being allowed to heat up above 80° F. (27° C.)—considered to be the max. safe temp.—owing to the

C

failure of refrigerating equipment. The mixture was used in the electrolytic polishing of aluminium.—G. T. C.

X.—REFINING

*Reduction of Magnesium Chloride by Calcium Carbide. Lloyd R. Michels, Burke Cartwright, and S. F. Rivitz (*U.S. Bur. Mines Rep. Invest.* No. **4059,** 1947, 8 pp.).—An examination of the reaction $CaC_2 + MgCl_2 = Mg + CaCl_2 + 2C$, from the point of view of its possible utility in the commercial production of magnesium. Thermodynamic data are given, and experimental work on the reaction, using welded-steel bombs, is reported. The magnesium formed by the reduction was present as minute particles, so intimately mixed with the other reaction products that it could not readily be separated; and it was concluded that the reaction does not afford a promising method for the commercial production of magnesium.—F. A. F.

*The Place of Yttrium and the Application of Ferricyanide Precipitation in the Rare-Earth Group. The Purification of Erbium. (Marsh). See p. 1.

XI.—ANALYSIS

Polarographic Determination of Zinc in Aluminium Alloys. W. Stross (*Metallurgia*, 1947, **36**, (213), 163–166).—The difficulties of devising a method of polarographic analysis of wide application are discussed, and a method described which is claimed to be generally applicable to the determination of Zn in Al alloys. This utilizes the fact that Zn gives a good wave in NaOH solution; as Al is reduced at a more negative potential than Zn, its presence does not interfere. The method is usable on a semi-micro or micro scale.

—M. A. V.

*Acid Titration of the Aluminium Ion. S. Lacroix (*Anal. Chim. Acta*, 1947, **1**, (1), 3–12).—[In French]. A method is described of determining Al and free acid in an acid solution containing [Al^{3+}] ions. An excess of oxalate or hydrofluoride ions is added to the solution, which retards the precipitation of $Al(OH)_3$ during titration of the free acid with NaOH, using bromothymol blue as indicator. Al is determined by simultaneous titration of the [Al^{3+}] ions and the free acid, the Al content being determined by difference. In this titration, an excess of NaOH is added and a back titration with HCl is made at the boiling point, again using bromothymol blue as indicator. These two titrations enable the free acid and [Al^{3+}] to be determined to within 0·3%. An extension of the method, for determining [Al^{3+}] and [Fe^{3+}] in the presence of free acid, is described.—R. W. R.

*Method of Qualitative Analysis of Cations Without Systematic Separations. I.—Reactions of Arsenic, Tin, Antimony, Bismuth. G. Charlot and D. Bézier (*Anal. Chim. Acta*, 1947, **1**, (2), 113–123).—[In French]. C. and B. have previously advanced a method for the qualitative analysis of cations in which separations are reduced to a minimum, each metal being detected by an individual specific test (see *Ann. Chim. Anal. Appl.*, 1943, **25**, 90, 114), and are now evolving refined methods for the detection of small quantities of an element in the presence of large quantities of other cations. In this paper, B. presents such methods for As, Sn, Sb, and Bi. As is detected with a molybdate reagent or by reaction with Al in alkaline solution, Sn by reaction with I_2–KI solution, Sb with Rhodamine B, and Bi by reaction with $SnCl_4$.—R. W. R.

The Determination of Tin and Copper in Phosphor Bronze. Brian B. Bach (*Metallurgia*, 1947, **36**, (212), 65–66).—Methods of determining Sn and Cu in

tin bronze by electrodeposition are described. These were specially designed to overcome difficulties due to the presence of P, and are accurate without being unduly slow.—M. A. V.

*Colorimetric Determination of Calcium in the Presence of a Large Excess of Magnesium. Emile Rinck and (Mlle.) Hélène Ostertag (*Compt. rend.*, 1947, **224**, (15), 1108–1110).—H. Beutelspracher (*Z. anal. Chem.*, 1934, **96**, 161) has described a method of micro-analysis of Ca by precipitation with Na_2WO_4. R. and O. found that this method was not very accurate, especially in the presence of large amounts of Mg, owing to the formation of double para-tungstates of Na and Mg, insoluble in water. They showed that the formation of these compounds could be prevented by not evaporating the precipitating solution to dryness as recommended by B. They describe their method in detail.—J. H. W.

*Rapid Titration of Chromium and Vanadium. L. Ducret (*Anal. Chim. Acta*, 1947, **1**, (2), 135–139).—[In French]. Cr and V, present together in solution as Cr^{3+} and V^{4+} in concentrations between $N/10$ and $N/100$, may be determined as follows : The total content of both elements is first determined by titration with $N/10$-Fe^{2+} solution, in 2–3N-H_2SO_4 solution, using sulphonated diphenylamine as an oxydo-reduction indicator. The V^{3+} in the solution is then oxidized to V^{4+} by an excess of $KMnO_4$ ($N/10$) and this excess of $KMnO_4$ is destroyed by the addition of 2 c.c. of a 1% solution of sodium azide. The titration with $N/10$-Fe^{2+} is then repeated as before, and the V content thus obtained. About 5 c.c. of 85% H_3PO_4 must be added before each titration. The accuracy of the estimation is about 0·2%.—R. W. R.

*Methods of Analysis of Chromium-Plating Solutions. F. W. Salt (*J. Electrodepositors' Tech. Soc.*, 1947, **22**, 15–18).—Methods are described for the complete analysis of a chromium-plating solution in $1\frac{1}{2}$ hr., as against at least 4 hr. by other methods. Chromic acid and trivalent Cr (after oxidation) are determined by titration with ferrous ammonium sulphate using N-phenyl-anthranilic acid as indicator. Fe is estimated by reduction with stannous chloride and titration with potassium dichromate, using barium diphenylamine sulphonate as an indicator. Alternative methods are given for trivalent Cr and Fe when the former is present in only small quantities. Sulphate is determined by precipitation in the presence of picric acid, which increases the particle size of the precipitate and thus enables it to be filtered immediately.—G. T. C.

*Analysis of Gold and Gold Alloy [Plating] Solutions. Edward A. Parker (*Monthly Rev. Amer. Electroplaters' Soc.*, 1947, **34**, (1), 33–40).—P. describes methods of estimating Au, Ni, and Cu in plating solutions used for the deposition of pure Au and coloured alloy Au. For the estimation of Au, a modification of Herschlag's method is developed. As finally modified, this involves the elimination of cyanides with HCl and H_2SO_4, the removal of excess nitrites with hypochlorite, followed by neutralization with bicarbonate. KI is added, and titration carried out with arsenious oxide. At pH 7–8, Fe'', Fe''', Zn'', Sn'', SnO_3^{--}, Ni'', Ag', Cu', and Cu'' have no effect unless their basic salts are coloured, and even then it is not serious. For Ni, a colorimetric method based on the use of dimethylglyoxime is used. For Cu, Mehlig's Cu–ammonia-complex method is modified. It is a colorimetric method, and suffers from interference in presence of Ni and such ions as chromates. These are unlikely to be present in sufficient quantity to be serious. Full analytical details are given for the three determinations.—G. T. C.

*Determination of Impurities in Electroplating Solutions. (A.E.S. Research Project No. 2.) V.—Manganese in Nickel-Plating Baths. VI.—Traces of Copper in Nickel-Plating Baths. Earl J. Serfass and W. S. Levine (*Monthly Rev. Amer. Electroplaters' Soc.*, 1947, **34**, (3), 320–327 ; (4), 454–462).—Cf. *Met. Abs.*, 1947, **14**, 122. (V.—) After reviewing the possible methods, the

authors describe in detail one in which the Mn is oxidized to permanganate with sodium periodate in an acid mixture of phosphoric and perchloric acids. The colour of the resulting solution, after suitable dilution, is measured with a colorimeter. Most ions do not interfere with the determination except when coloured. Cu, Ni, and chromates are compensated for by adding a similar quantity to a blank. Ag, Pb, and Hg give no precipitate if enough acid is present. However, Bi and Sn do give precipitates, even in the presence of acid. Full experimental details of the investigation and the method used are given. The method was found suitable for all-chloride, 50 : 50 sulphate–chloride, high-sulphate, and Watts types of Ni bath. (VI.—) After reviewing past work on the determination of small amounts of Cu in Ni-plating solutions, the authors describe a method in which the Cu is precipitated from the solution by means of 2-mercaptobenzothiazole. The precipitate is extracted with amyl acetate, and the colour developed by adding dibutyl amine and carbon disulphide. The colour is measured with a colorimeter after dilution with ethyl alcohol. The method is applicable in the presence of chromates, silicates, Ca, Al, Cd, Pb, Fe'', Fe''', and Mn. The precision of the method is $\pm 2\%$. Full details of the development work and of the method itself are given. It is applicable to all-chloride, 50 : 50 sulphate–chloride, high-sulphate, and Watts types of Ni solution.—G. T. C.

***Estimation of Nickel, Cobalt, Chloride, Formate, and Formaldehyde in Nickel–Cobalt Plating Solutions.** F. W. Salt (*J. Electrodepositors' Tech. Soc.*, 1947, **22**, 19–21).—All methods given are volumetric and applicable in the presence of boric acid. Titration with silver nitrate is used for Ni, Co, and chloride. Formaldehyde is estimated by heating with I_2 and titrating the excess with sodium thiosulphate. Sodium formate is determined, after evaporation nearly to dryness, by addition of potassium permanganate, sodium carbonate, and potassium iodide, followed by titration with sodium thiosulphate.—G. T. C.

***Apparatus for Anodically Stripping Electrodeposits from One Side of a Sheet for Analytical Purposes.** (Price). See p. 16.

***Determination of Free Sodium Hydroxide and Sodium Carbonate in Plating Solutions.** (Silverman). See p. 16.

***Detection of Scandium, Rare Earths, Zirconium, and Thorium with Murexid.** G. Beck (*Anal. Chim. Acta*, 1947, **1**, (1), 69–71).—[In German]. The reactions with murexid of Sc, Zr, Th, the rare earths, and other elements are briefly described, and qualitative tests for these elements using murexid reagent are given. The presence of Al or Be does not interfere. Further tests for discrimination between the elements are suggested. A titrimetric method for the estimation of Sc, using murexid and nitrilotriacetate, is proposed.
—R. W. R.

***The Electrolytic Determination of Thallium.** Jean Besson (*Compt. rend.*, 1947, **224**, (17), 1226–1227).—B. briefly points out the disadvantages of each of the many methods previously proposed for the electrolytic determination of Tl. He investigated the nature of the oxide of Tl deposited at the anode in the electrolysis of a Tl salt in an acid solution, and shows that it is neither the dioxide, TlO_2, nor the intermediate oxide, Tl_3O_5, but the ordinary sesquioxide, Tl_2O_3. The electrometric reduction of this oxide is not suitable as a method of determining Tl, as it is difficult to effect this quantitatively.—J. H. W.

Applications of Polarography to Metallurgical Analysis. J. Heyrovsky (*J. Proc. Roy. Inst. Chem.*, **1947**, (II), 82–83).—A lecture to the Sheffield, S. Yorkshire, and N. Midlands Section of the Royal Institute of Chemistry. H. reviews polarographic analysis and its application to the determination of impurities in metals. The use of a streaming-mercury electrode and cathode-ray oscillograph in quantitative analysis by the polarographic method is outlined.—H. J. A.

Polarographic Methods of Analysing Metals. M. Spalenka (*Fonderie*, 1946, **1**, (12), 466–467).—A review.—M. E.

*Spectrochemical Analysis by the Copper Spark Method. Mark Fred, Norman H. Nachtrieb, and Frank S. Tomkins (*J. Opt. Soc. Amer.*, 1947, **37**, (4), 279–288).—Spark spectra of solutions in HCl evaporated to dryness on Cu rods are recommended to combine the sensitivity usually obtained from arc spectra with the reproducibility of spark sources. Freshly turned, hard-drawn Cu rods, $\frac{1}{4}$ in. in dia., with flat ends were treated with 0·1 ml. of acid solution and dried in coils of Nichrome resistance wire, heated so as to evaporate the liquid without visible boiling. Spectra were examined by visual comparison with test plates from solutions of known concentration; the sensitivity for 64 elements is tabulated. Quantitative results obtained with Mo, Pb, or other suitable internal-standard elements had average deviations of 3–8% and less sensitivity. The method has been applied to the purification of plutonium; the precautions needed to get optimum results are described in detail.

—E. van S.

*Flame Spectra of Copper Salts. Nand Lal Singh (*Proc. Indian Acad. Sci.*, 1947, [A], **25**, (1), 1–21).—A paper on visual lines which might be of use in the selection of internal standards for the visual estimation of impurities in Cu.

—E. van S.

A Method of Semi-Quantitative Spectrographic Analysis. C. E. Harvey (*J. Opt. Soc. Amer.*, 1946, **36**, (12), 719).—A summary of a paper, read before the Optical Society of America (later published as a booklet), on a rough quantitative spectrographic method, applicable to any metallic or non-metallic material, for the estimation of about 40 metallic elements, as well as B, P, and Si. The method depends on the complete vaporization of the sample in an arc, and on measurements of selected spectrum lines, which are compared with the background for intensity and evaluated by means of factors which depend on the matrix of the mixture arced.—E. van S.

*Use of Incompletely Consumed Samples to Illustrate Effect of Fractional Distillation in Carbon-Arc Spectrochemical Analyses. Lester W. Strock and George E. Heggen (*J. Opt. Soc. Amer.*, 1947, **37**, (1), 29–36).—When mixtures of NaCl with alkali earth salts are being vaporized in the carbon arc for analysis, either BeO or Cr_2O_3 may be added as an internal standard. If the arcing is continued till the samples are completely consumed, tolerable results are obtained with Be, but if the exposure is stopped before all the Na is burnt off, Cr comparison lines give better results. The reasons for this difference are examined in detail and explained.—E. van S.

The Calculation of Line Strengths from Laboratory Data. William Petrie (*Canad. J. Research*, 1947, [A], **25**, (1), 42–48).—The line strength is one of the parameters on which the calculation of line intensities is based, and data are provided which may be of use in the selection of lines for comparison in analysis.—E. van S.

*A Slit-Less Spectrograph. Raymond Ricard (*Compt. rend.*, 1946, **222**, (19), 1091–1092).—After enumerating some of the practical difficulties of a normal spectrograph, R. describes how the slit may be replaced by the brilliant virtual focus of a polished cylinder forming a cylindrical convex mirror. In preliminary work, a steel needle, dia. 1 mm., was used as reflecting cylinder, with a sodium lamp and an iron arc as sources. Very clear spectra were obtained for all positions of the sources, without refocusing. The instrument possesses the following advantages for spectrum analysis : the spectrum of all the source is observed; small displacements of the source produce only second-order effects on the illumination of the prism ; the reflecting power of the cylinder does not enter the calculations ; and spectra may be obtained from moving sources, or sources whose position cannot be adjusted beforehand (e.g. lightning). By coating the cylinder with Al, spectroscopy in the ultra-violet

may be carried out. Being achromatic, the reflecting cylinder is better than the cylindrical diverging lens described by King (*J. Opt. Soc. Amer.*, 1946, **36**, 164 ; see *Met. Abs.*, 1946, **13**, 305).—D. P. M.

A New Device of Quantitative Spectrography. Aymé Cornu (*Compt. rend.*, 1946, **222**, (23), 1341–1342).—A slightly modified Feussner circuit is used to supply two sparks, one between standard alloys and the other between the samples examined, the electrode separation being equally regulated. The slit-less spectrograph of Ricard (see preceding abstract) is used, the separation of the pseudo-slits being about 1 mm. Irregularities in the emulsion are eliminated, the sparks are excited under identical conditions, and the times of exposure are equal. For complicated spectra, the dispersion may be increased without sacrificing the simplicity of the system.—D. P. M.

General Review of the Present Position of Quantitative Spectrographic Analysis. J. Gillis (*Anal. Chim. Acta*, 1947, **1**, (1), 38–49).—[In English]. A review of recent published information.—R. W. R.

XII.—LABORATORY APPARATUS, INSTRUMENTS, &c.

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

*A Simple Method for Producing Good Front-Surface Mirrors [Aluminium Films on Glass]. Noel W. Scott (*J. Opt. Soc. Amer.*, 1946, **36**, (12), 711).—A summary of a paper on the deposition of aluminium films on glass, for use as front-surface mirrors, and on the protection of these films by a transparent surface film of SiO. After the aluminium has been deposited, a mixture of Si and SiO_2 is evaporated from a boat of tungsten or tantalum in the vacuum apparatus, and the mixture gives vapour of SiO, which forms a more adhesive film on aluminium than SiO_2 can form. The abrasion resistance is tested with a steel ball wrapped in linen and loaded with a 500-g. weight, which would mark an aluminium surface in a single movement. Similar mirrors can be formed on metal bases, with an intermediate film of SiO between the base metal and the aluminium, or even on some plastics.—E. van S.

Instrument Threads [Standardization]. G. A. Whipple, W. O. Davis, and A. D. Snutch (*Proc. Inst. Mech. Eng.*, 1946, **155**, (18), 152–154).—The authors present the results of discussions at an Anglo–Canadian–American series of conferences on the standardization of instrument threads. The conference considered instrument threads as : (1) fastening screws, (2) fine-motion screws, (3) bearing-adjustment screws, (4) optical mounting threads, and (5) attachment threads. The results of the discussions are tabulated, and, in general, with the possible exception of some micrometer screws, it is suggested that a Whitworth-form thread be adopted.—H. J. A.

Optical Methods for Evaluation of Metal Surfaces. Arthur A. Vernon and John Broomfield (*Metal Finishing*, 1947, **45**, (4), 70–71).—A brief review of the optical instruments available for the evaluation of the degree of smoothness of metal surfaces. Reference is made to instruments which show a picture of the surface and to one which measures accurately the light reflected from the surface.—G. T. C.

Optical and Allied Instruments Shown at the Physical Society's Exhibition [1947]. J. L. Haughton (*J. Sci. Instruments*, 1947, **24**, (6), 142–143).— Reference is made to an optical surface finish comparator made by Machine Shop Equipment, Ltd. This consists of a double microscope which enables the surface under examination to be seen beside a standard surface. A set of 8 standard surfaces are provided. Numerous travelling microscopes were shown.—W. H.-P.

Thermal and Mechanical Instruments Shown at the Physical Society's Exhibition [1947]. C. R. Barber (*J. Sci. Instruments*, 1947, **24**, (6), 144–145).—No outstanding achievements are noted, but references to pyrometers, furnaces, and dilatometers are of direct metallurgical interest. These include a colour-temp. pyrometer developed by H. Tinsley and Co. in conjunction with the B.I.S.R.A., and pyrometers based on lead sulphide photo-conductive cells. A " photo-electric brightness telepyrometer " made by the General Electric Co., Ltd., indicates differences of temp. as small as $2°$ C. at $1050°$– $1000°$ C., using about 1 in.^{2} of source at 15 ft. ; in its present form it is unsuited to absolute temp. measurements. A modified mercury-in-steel thermometer made by Negretti and Zambra, Ltd., can be used up to $650°$ C. A molybdenum furnace by the Wild-Barfield Electric Furnaces, Ltd., can be used up to $1700°$ C., and a new type of gas muffle using a recuperative system, exhibited by the Gas Light and Coke Co., enables a temp. of $1450°$ C. to be reached without forced draught.—W. H.-R.

Recorders and Controllers Shown at the Physical Society's Exhibition [1947]. K. M. Greenland (*J. Sci. Instruments*, 1947, **24**, (6), 146–148).—A new thermo-couple recorder by Sunvic Controls, Ltd., has a full-scale deflection of $\pm 10°$ C., and registers up to $1500°$ C. with a probable accuracy of $\pm\frac{1}{4}°$ C. It is provided with automatic standardization of the potentiometer voltage, and automatic protection in the event of failures. Courtauld's, Ltd., show a method of recording which is photographic but is visible without development. A high-intensity spot of light from a galvanometer mirror is focused on a moving sheet of printing-out paper. Several recorders using electronic amplification are mentioned. New cine-camera instruments are described, including applications for visible, infra-red, and X-ray radiation.—W. H.-R.

Electrical and Acoustical Instruments Shown at the Physical Society's Exhibition [1947]. T. B. Rymer (*J. Sci. Instruments*, 1947, **24**, (6), 148–151).—Much of general but little of direct metallurgical interest is included, although the following may be noted : (1) Cobalt-steel magnets formerly used in moving-coil meters have been completely replaced by materials such as Alcomax and Ticonal. (2) A few commercial applications of supersonics were shown. In one of these, the thickness of a metal plate is gauged by placing a piezo-electric supersonic generator in contact with one face and adjusting the frequency until resonance is obtained ; the thickness of the plate can then be determined from the known velocity of sound in the metal. Another application is the detection of flaws in a metal. A supersonic generator is placed in contact with one face of the specimen under test. Flaws cause scattering of the resulting sound waves in the metal, and the scattered sound waves are picked up on a detector, and shown on a cathode-ray tube.—W. H.-R.

Summarized Proceedings of Conference on the Electron Microscope, Oxford, 1946. V. E. Cosslett (*J. Sci. Instruments*, 1947, **24**, (5), 113–119).—The first session dealt with the construction of electron microscopes of different types. *G. D. Preston* contributed a paper on the principles of the imaging process. *M. E. Haine* dealt with the limiting factors of a practical nature encountered in designing electron microscopes, and described the instrument being produced by the Metropolitan-Vickers Electrical Co. In the projection-lens system, the limiting factor is distortion of the field, and this is eliminated by employing a double projection lens. The main magnification is provided by the first lens, while the second lens runs at const. power, using a small area only of the field between the poles. *J. B. Le Poole* described the electron microscope developed during the war at Delft. This was a 3-stage instrument employing 5 water-cooled magnetic lenses. *A. C. Van Dorsten* described the microscope now being developed by Philips of Eindhoven on the basis of Le Poole's work. *W. J. Oosterkamp* gave an account of an experimental electron microscope for 400 kV., in order to obtain greater penetrating power of the beam. *G. Dupouy*

(University of Toulouse) has developed a 2-stage magnetic microscope which exhibits many ingenious mechanical ideas. *H. Bruck* (Paris) spoke of work on electrostatic lenses, and of an electrostatic microscope in which they were used. The best resolution obtained was about 80 Å. *D. Gabor* (Rugby) discussed phase-contrast phenomena in electron microscopy, and the possibility of revealing the structure of objects too thin to be revealed by differential scattering. It might be possible to correct electron optical systems by drying a thin film over a fine aperture; if the form of the film were a fourth-order parabola, the aberrations of the electron microscope could be reduced to about half the limit calculated for existing systems. He summarized a long communication from *O. Scherzer*. The session closed with a lively discussion of the points raised. The next session was concerned mainly with problems of specimen preparation. *D. G. Drummond* (Manchester) gave a general review, including surface-replica methods. *W. M. Jones* (Harwell) described a method of taking surface replicas, using methyl methacrylate instead of polystyrene; this enables the impression to be taken at room temp. and pressure. A silica film is then prepared, and good results have been obtained with pearlite. *R. Garrod* read a paper on the measurement of surface topography, and *R. V. Scott* made critical remarks on the technique of shadow casting. The final session was concerned with papers on applications of electron microscopy. *W. H. Walton* and *W. J. Harris* dealt with applications to particle-size measurements, and *G. Dupouy* described investigations including anodic replicas of aluminium surfaces after different treatments. The degree of etching of aluminium specimens of different purity was strikingly demonstrated.—W. H.-R.

A Magnetic Electron Microscope with High Resolving Power. Gaston Dupouy (*J. Phys. Radium*, 1946, [viii], **7**, (11), 320–329).—An illustrated account of the first electron microscope entirely built in France. Its characteristics are : 70–250 kV. ; vacuum, 10^{-5} mm. of mercury ; and resolving power, 20–30 Å.—M. E.

New Developments in Electron Microscopy. J. L. Farrant (*Elect. Eng. Merchandiser*, 1947, **23**, (10), 315–319).—A review.—H. J. A.

*****Apparatus for Measuring Power Loss in Small Ferromagnetic Samples Subject to an Alternating Magnetic Field.** K. H. Stewart (*J. Sci. Instruments*, 1947, **24**, (6), 159–162).—An apparatus is described which enables loss measurements to be made at known flux densities on flat strip specimens, about $15 \times 1 \times 0.03$ cm., of soft magnetic materials. Frequencies of between 10 and 150 c./s. can be used.—W. H.-R.

*****Photo-Electric Spectrometer to Record Faint Illumination.** Alexandre Dauvillier (*Compt. rend.*, 1946, **222**, (18), 1042–1043).—D. describes the use of a photo-electric cell in the spectrometry of faint illuminations, thus eliminating the sensitometric and photometric operations necessary with a photographic plate. Electronic amplification enables spectra which require prolonged photographic exposures to be obtained in a few minutes, and the method is thus very useful for studying comets and auroræ. The application to a normal spectrograph with glass prisms and a dispersion of 109 mm. between 3800 and 8300 Å is described. The photo-electric cell uses a rubidium or silver cathode, giving good sensitivity between 2500 and 11,000 Å. The large dispersion enabled wide slits to be used, and the spectrum of neon, with a minimum illumination of 0.08 lumens, was obtained in a few minutes. A photographic plate is more sensitive below 5000 Å, but the photo-electric cell is better in the red and infra-red. With illumination by cathodic luminescence of neon, argon, and mercury, the spectra do not pass beyond 5900 Å with panchromatic plates (Agfa Isopan) or 7800 Å with special infra-red plates (Kodak). The photo-cell method picks up rapidly the fluorescence curves of organic substances or of crystals illuminated with ultra-violet light.—D. P. M.

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

*A Rapid Method for Accurate Yield-Strength Determination Without Stress–Strain Curves. L. J. Ebert, M. L. Freid, and A. R. Toole (*Bull. Amer. Soc. Test. Mat.*, 1947, (**145**), 50–52 ; discussion, 52–53).—The authors describe a method by which the yield strength of non-ferrous materials may be determined rapidly by a single operator and without an automatic load–elongation recorder. Charts have been constructed relating yield loads and total elongations to yield strengths, for test specimens of various cross-sectional areas. From these charts, it is possible to estimate the correct extensometer reading (total elongation) at which to read the actual yield load from the tension machine dial. The errors involved in the rapid method are of the same order as those involved in making the measurements. In discussion, it is stressed that the method is suitable only for use with metals of known elastic moduli.—H. J. A.

Proof Loading—An Essential Non-Destructive Test. John C. New (*Indust. Radiography Non-Destructive Test.*, 1947, **5**, (4), 37–40).—A review of the scope of proof testing, with special reference to the simultaneous use of strain-sensitive brittle lacquers or wire resistance strain-gauges on the surface of the specimen.—L. M.

Observations on Conducting and Evaluating Creep Tests. W. Siegfried (*J. Iron Steel Inst.*, 1947, **156**, (2), 189–207).—S. stresses the importance of a knowledge of the creep properties, especially under multi-axial stressing, of the heat-resisting materials used for gas-turbine blades, and discusses testing procedure. The dangers of extrapolating to long periods of time, tests which only occupy a few hundred hours are emphasized, and it is pointed out that the stress/time-to-rupture curve frequently shows a discontinuity at long times. It is suggested that the presence of such discontinuities may sometimes be deduced from observations of changes taking place in other physical properties (e.g. magnetic saturation) during short-time tests. It is important that creep tests be made on both smooth and notched specimens, so that the separate influences of notching and multi-axial stressing may be assessed. S. reviews the work of Kuntze, McAdam, and others, presents the results of sustained-load tests at elevated temp. on a number of steels, and makes some deductions with regard to the notch sensitivity and the behaviour of these materials under multi-axial stressing. S-shaped tenacity curves (true stress/reduction of area) are given which show that time of testing exerts a profound influence on the deformation characteristics of the materials. Some practical recommendations are made for testing materials at elevated temp.

—R. W. R.

Some Aspects of Hot-Hardness Testing. K. G. Robinson (*Metallurgia*, 1947, **36**, (211), 45–46).—Impact and indentation methods of testing hot hardness are discussed critically. Static testing is recommended, using steel balls up to 200° C., and sintered carbide balls up to 800°–900° C. At higher temp., impact testing may be preferable.—M. A. V.

*A New Micro-Hardness [Testing] Apparatus, the " Microscléromètre L.C." Robert Girschig (*Rev. Mét.*, 1946, **43**, (3/4), 95–112 ; and (summary) *Indust. Diamond Rev.*, 1947, **7**, (80), 208–211).—Presented to the Société Française de Métallurgie. G. has invented a new hardness-testing machine which makes impressions 0·01 mm. in size with a load of 10 g. The load is applied by a plate spring which is loaded with weights. G. studies the possibility of measuring the hardness of single grains. Only one grain must be involved. The probability of a good hardness measurement is :

$p = \dfrac{1 - d/r_0 \sqrt{1 - (a/r_0)^2}}{2}$, where $2d$ is the dia. of the affected zone, and $2r_0$ the grain dia. If P is the load, P/d^2 is not a constant.—M. E.

†**Magnetic Testing.** Raymond L. Sanford (*U.S. Nat. Bur. Stand. Circ.*, 1946, (**C456**), 40 pp.).—The subject matter is dealt with under these headings : (1) introduction, (2) magnetic quantities and units, (3) magnetic characteristics of materials, (4) tests with D.C., (5) tests with A.C., (6) magnetic properties of typical materials, (7) magnetic analysis, and (8) tables of data and references to the literature.—H. J. A.

Testing Materials for Internal Discontinuities with Supersonic Echoes [**Reflectoscope**]. J. W. Dice (*Indust. Radiography Non-Destructive Test.*, 1947, **5**, (4), 29–33).—A detailed account of the (Sperry) supersonic Reflectoscope, which utilizes supersonic waves (from 0·5 to 12 Mc./s.) to detect discontinuities in metals. The apparatus permits a penetration in aluminium of 28 ft. (24 ft. in steel).—L. M.

Use of " Magnaflux " and " Zyglo " for Non-Destructive Testing. K. E. Glover (*Indust. Radiography Non-Destructive Test.*, 1947, **5**, (4), 41–44).—A review of the scope and technique of (1) magnetic methods for detecting surface cracks and sub-surface discontinuities in magnetic materials, and (2) the use of fluorescent salt suspensions, in conjunction with viewing by near-ultra-violet light, for the detection of surface discontinuities, including cracks, in both magnetic and non-magnetic materials.—L. M.

RADIOLOGY

Gun-Metal Castings. Radiographic Tests. William H. Baer (*Amer. Foundryman*, 1947, **11**, (4), 111–116).—A general illustrated review, in which is described the appearance of radiographs of defects due to gas porosity, shrinkage, and blow-holes.—J. E. G.

Some Photographic Aspects of Industrial Radiography. Herman E. Seemann (*Indust. Radiography Non-Destructive Test.*, 1947, **5**, (4), 9–15).—A detailed description of image formation and film processing, with special reference to X-ray films. In discussing lead and salt intensifying screens, reference is made to the use of a lead screen in making electron micrographs. The thin specimen is placed between a front lead screen and the film. X-ray radiation incident upon the lead generates electrons which, passing through the specimen, produce the image.—L. M.

XIV.—TEMPERATURE MEASUREMENT AND CONTROL

A Symposium on the Contamination of Platinum Thermocouples. ——
(*J. Iron Steel Inst.*, 1947, **155**, (2), 213–234 ; and (summary) *Iron and Steel*, 1947, **20**, (6), 232–241).—An introduction to a symposium consisting of six papers (abstracted below) covering work done during the last few years to elucidate the causes of the contamination of platinum thermocouples at steel-making temp. The conclusions reached are briefly reviewed in this introduction.—R. W. R.

*An Investigation of the Embrittlement of Platinum–Rhodium Wire in the Heads of Liquid-Steel Pyrometers.** T. Land (*J. Iron Steel Inst.*, 1947, **155**, (2), 214–215).—Lengths of platinum–rhodium wire were heated at 1000° C. for 1 hr. in thermocouple sheath assemblies, the different parts of which were made from the following materials : steel, graphite, silica, Sairset cement, and asbestos. The experiment was repeated with different combinations of materials omitted so as to isolate the contaminant. The couple wires were subsequently tested for embrittlement by a tension test, the load being

measured on a spring balance. Brittle fractures were obtained with all combinations of materials involving new steel tubes, but, when well burnt-out steel tubes were used, ductile fractures were generally obtained. The embrittlement is ascribed to the presence of oil and other carbonaceous materials in the steel tubes.—R. W. R.

*Fracture of Platinum and Platinum–13% Rhodium Wires Used in the Immersion Thermocouple.** L. Reeve and A. Howard (*J. Iron Steel Inst.*, 1947, **155**, (2), 216–220).—The intercrystalline attack commonly experienced by wires in the Schofield–Grace immersion thermocouple was investigated by heating specimens of platinum–rhodium wire in the presence of oil, in a graphite block, the wires being placed in a silica insulator. Attack was found to be rapid above 1200° C., and a standard test was evolved in which specimens $\frac{3}{4}$ in. long were heated at 1400° C. for 15 min. in the presence of 0·05 c.c. oil, of sulphur content 0·2%. Specimens of wire in the fully cold-worked, partially annealed, and fully annealed states were examined, and it was found, by subsequent micro-examination, that the partially annealed wires were most susceptible to attack, and also showed more marked grain coarsening. A further observation was that, in the presence of the silica insulator, swelling frequently occurred at the portion of the wire just leaving the insulator : max. attack was found to have occurred at this point. Spectrographic analysis showed the presence of the following elements in the contaminated wires : copper > silicon > manganese > nickel > iron. The conclusions of Chaston *et al.*, that contamination is caused by the co-presence of sulphur and silica (see abstract below), was confirmed by substituting an alumina insulator for the silica one, and by replacing the oil by flowers of sulphur or by liquid paraffin. Attack was only observed with those combinations of materials containing both sulphur and silica. Oil tests carried out on pure platinum revealed a similar kind of intercrystalline attack. It was found that, in practice, attack could be prevented by baking the iron protection tubes at a dull-red heat in the presence of a current of air.—R. W. R.

*An X-Ray Investigation of the Embrittlement of Platinum and Platinum–Rhodium Wires.** H. J. Goldschmidt and T. Land (*J. Iron Steel Inst.*, 1947, **155**, (2), 221–226).—The authors describe the results of X-ray diffraction studies of the following thermocouple materials : platinum, platinum–13% rhodium, and pure rhodium wires artificially contaminated by a method similar to that used by Reeves and Howard (see preceding abstract), a platinum–13% rhodium wire accidentally contaminated with quenching oil, and a thermocouple which had failed in service. A 9-in.-dia. Debye–Scherrer camera was used, employing cobalt radiation for the platinum-rich materials and copper radiation for the rhodium-rich materials, and a preliminary study of the system platinum–rhodium was made, using prepared standards. Observed lattice parameters for the pure materials were $3\cdot9161$ ($\pm0\cdot0001$)a_0 kX. (platinum) and $3\cdot7968$ ($\pm0\cdot0001$)a_0 kX. (rhodium). Measurement of the parameters of a series of standard alloys revealed a small divergence from Vegard's Law in the direction of larger values of the parameter. Within the range 0–30% rhodium it is possible to determine the rhodium content to within $\pm0\cdot1\%$ from lattice-parameter measurements, using the following formula : $C = 903\cdot1(3\cdot9161 - a_0) - 1296(3\cdot9161 - a_0)^2 + 6300(3\cdot9161 - a_0)^3$, where C is the atomic percentage of rhodium. A brief investigation of the system platinum–silicon was made. Silicon was found to have a small solid solubility in platinum, and two silicides were detected, these being formed by the addition of 1% silicon to pure platinum (silicide " P "), and to platinum–13% rhodium (silicide " R "). Phases detected in the artificially contaminated wires were : " P " (in pure platinum) and " R " (in the 13% alloy). The platinum leg of the couple which failed in service showed an additional, unidentified phase, " Q ", and the alloy leg of this couple contained " Q " only.

The matrix of the accidentally contaminated wire was found to have split into two phases, one rhodium-free (platinum black), the other containing $19 \cdot 6\%$ of rhodium; phases " P " and " Q " were also present, these being confined to the platinum- and rhodium-rich parts respectively. The phase splitting in this wire is clear evidence of reaction with another element which enters into solid solution in pure platinum. Embrittlement is thought to be caused by the presence of phases " R " and "Q ", while phase " P " is considered relatively ductile.—R. W. R.

*Contamination and Failure of Rare-Metal Thermocouples. D. Manterfield (*J. Iron Steel Inst.*, 1947, **155**, (2), 227–229).—M. describes the results of visual and X-ray examinations of six thermocouples which failed in service. The couples had been used to measure temp. in solidifying steel ingots, and had been protected from the molten metal with silicon insulators and sheaths. The X-ray examination showed that the following impurities were present near the points of failure in the platinum wires : (1) a platinum–silicon compound, (2) magnesium silicate, (3) magnesium hydroxide, (4) a silicon-rich phase, and (5) γ-iron; contaminants found in the platinum–rhodium wires were (4) and (5) above, and a platinum–rhodium–silicon compound. Some suggestions as to the origins of the contaminants are made.

—R. W. R.

*Embrittlement of Platinum/Platinum–Rhodium Thermocouples. J. C. Chaston, R. A. Edwards, and F. M. Lever (*J. Iron Steel Inst.*, 1947, **155**, (2), 229–231).—The authors describe tests in which pure platinum and platinum–13% rhodium wires were heated in contact with carbon, sulphurous vapours, and hydrocarbon vapours ((*a*) xylol and (*b*) white spirit). None of these substances gave rise to embrittlement when employed alone, but severe attack occurred when sulphur and carbon were present simultaneously at 1200° C. and above. No attack occurred at 1100° C. or below. Chemical analysis of the attacked wires revealed the presence of silicon, but no carbon or sulphur. The explanation advanced is that the sulphur combines with the silicon in the refractory of the furnace lining, forming volatile SiS_2 which attacks the platinum; the presence of carbon is necessary to catalyse this reaction. This explanation was confirmed by substituting fused alumina for the siliceous furnace lining, when no attack occurred.—R. W. R.

*Examination of the Microstructure of Contaminated and Embrittled Platinum and Platinum–Rhodium Wires. R. C. Jewell (*J. Iron Steel Inst.*, 1947, **155**, (2), 231–234).—J. reports the results of micrographic and spectrographic examination of (*a*) the wires examined by Manterfield, (*b*) the wire accidentally contaminated by quenching oil and examined by Goldschmidt and Land, and (*c*) the service failure referred to by Goldschmidt and Land (see preceding abstracts). The failure of wire (*a*) was due to severe attack by silicon (greatest for the platinum–rhodium wire), a brittle eutectic being formed. The silicide phase in the platinum–rhodium wire was microscopically distinguishable from that formed in the pure platinum wire, showing more relief and a bluish tinge, and exhibiting considerable segregation. These two constituents are respectively the " R " and " P " phases of Goldschmidt and Land. Contamination of wires (*b*) and (*c*) was similar, taking the form of intercrystalline attack; similar unidentifiable constituents were present in both instances (probably the constituent " Q " referred to by Goldschmidt and Land).—R. W. R.

*A Photo-Electric Pyrometer for a Small High-Frequency Induction Furnace. T. Land and H. Lund (*J. Iron Steel Inst.*, 1947, **156**, (1), 75–77).—The authors describe a photo-electric pyrometer designed primarily for the measurement of temp. of molten permanent-magnet alloys in a high-frequency induction furnace of 100-lb. capacity. Radiation from the surface of the metal is focused by a simple optical system on to a barrier-layer-type photo-cell. The output from the photo-cell is measured by a micro-ammeter calibrated in

° C., and a variable shunt resistance enables the sensitivity of the instrument to be varied so as to compensate for variations in emissivity of between 0·33 and 1·0. The dial of this resistance is graduated in terms of emissivity. The estimated accuracy of the instrument is $\pm 10°$ C.—R. W. R.

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Thermal and Mechanical Instruments Shown at the Physical Society's Exhibition [**1947**]. (Barber). See p. 23.

XXIV.— BIBLIOGRAPHY

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[The book summarizes the results of a number of years' work by the author on the corrosion of metals. The main divisions of the book are : (1) Theory of the Electrochemical Corrosion of Metals, (2) Theory of Cathodic Processes in the Corrosion of Metals with Oxygen Depolarization, (3) Experimental Study of Various Cathodic Materials, (4) The Effect of the Size, Shape, and Position of the Cathodic Surface on the Effectiveness of the Work of the Cathode, and (5) The Application of Polarization Curves to Problems of the Corrosion of Metals. The principal conclusions are given in a seven-page English summary.]

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XXV.—BOOK REVIEW

Aluminium Alloy Castings : Their Founding and Finishing. By E. Carrington.
Med. 8vo.   Pp. viii + 326, with 121 illustrations and 12 tables.   1946.
London : Charles Griffin and Co., Ltd.   (25s.)

The past decade has been one of steady development in the aluminium foundry indus'ry and the author has attempted in this book to give a full and up-to-date account of the processes involved in the production and after-treatment of aluminium sand castings, gravity die-castings, and pressure die-castings. The chapter headings may be quoted to show the range of the book : (1) Quotations; (2) Pattern and Die Making; (3) Melting; (4) Sand Control; (5) Moulding and Sand Casting; (6) Die Preparation, Gravity and Pressure Die-Casting; (7) Fettling and Repairing; (8) Heat-Treatment; (9) Inspection and Laboratory Assistance; (10) After-Treatment; (11) Machining; (12) Corrosion; (13) General. Organization; and (14) Future Outlook.

It will be appreciated at once that the author has set himself a very formidable task, and the treatment of some of the sections must, in a book of ordinary dimensions, necessarily be superficial. As stated in the preface, the author's aim, however, is to give a broad picture of aluminium foundry work for the benefit of the *foundryman*, and to this end he explains heat-treatment, degassing, and other metallurgical processes in simple and homely terms. The description and illustrations of foundry machinery, moulding, and casting methods are appropriate to a book of this type. The inclusion of a long and detailed statement of the duties of the metallurgist is less in keeping with the author's declared intentions, as also is the chapter devoted to corrosion. There is quite a lot of information in the book relating to foundry plant, equipment, and methods, and in the hands of, say, a foundry apprentice it may serve a useful purpose.

Still bearing in mind that the author did not set out to write a text-book but a book for foundrymen, the reviewer is left with a feeling that the foundrymen have not been particularly well served in the present volume. The selection, arrangement, and presentation of the subject matter certainly leave much ground for criticism. There are instances of undue emphasis on features which, it may be inferred, are of particular interest to the author, and the reader may form an unbalanced view of things as a result; the section dealing with the alloys used in the foundry may be used to illustrate this point. The 4·5%-copper alloy (D.T.D. 298, 304, and 361) is introduced first of all, and described as one of the " most important of all the alloys ". The aluminium–magnesium alloys to specification D.T.D. 300A and 165 are dealt with next, these being followed by a miscellany of alloys, including 3L5 (scarcely used at the present time, but referred to "as probably the best all-round sand-casting alloy "). Not until the end of the section do we find mention of the materials D.T.D. 424, L.33, and L.A.C. 112A, on which the greater part of our present-day casting production is based, and only the first two of these alloys are dealt with adequately.

The section on anodic treatment and dyeing which is based, presumably, on the results obtainable with wrought materials, is little less misleading and may give rise to some embarrassment to casting producers and metal finishers. The various anodic treatments are described and a long list of dye-stuffs quoted, and one would gather that it is the simplest matter to secure uniform coatings of any required colour on castings. No mention is made of the difficulties which arise from those small traces of porosity in castings, which at the present state of the art appear to be generally unavoidable; nor is it clearly stated that the alloys most readily cast and most generally used are suitable only for dark colours.

There are a host of other features in the book which will distract, puzzle, or irritate the reader.   He will be told that melts of D.T.D. 300A which have been allowed to exceed a temperature of 720° C. in the melting process should not be used for casting production but should be cast into ingots (no reason for this recommendation is given); and that L.33 which becomes contaminated with copper-bearing alloys should be discarded because it falls " outside specification " (the consequences of contamination with copper are not stated). Macrographs and micrographs are given and labelled " metal " (type of alloy and composition unstated); aluminium bronze is dealt with as though it were an aluminium-base alloy; the terms contraction and shrinkage are confused in a reference to billet casting; and pin-holing is said to be peculiar to aluminium alloys. Supervising inspectors will raise their eyebrows on reading that " the production of test bars (covering melts made in the production foundry) is a very important part of the work of the laboratory ". Even the English could be improved : segregation is defined as " a collecting together locally of some of the metals used to make up the alloy ".

Metallurgists and metallurgical students will find little useful to them in this book.—
R.·J. M. PAYNE.