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METALLURGICAL ABSTRACTS

(GENERAL AND NON-FERROUS)

Volume 15 NOVEMBER 1947 Part 3

I.—PROPERTIES OF METALS

[**Discussion on E. V. Potter and H. C. Lukens's Paper :**] "**Solubility of Hydrogen in Electrolytic Manganese and Transition Points in Electrolytic Manganese.**" —— (*Metals Technol.*, 1947, **14**, (4); *A.I.M.M.E. Tech. Publ.* No. **2187**, 37–40).—Cf. *Met. Abs.*, 1947, **14**, 1. *W. R. Ham* and *C. H. Samans* discuss the transition points in manganese. They point out that iron, nickel, and cobalt when present as oxides in glasses undergo transitions, the temp. of which follow series laws of the type $T_n = c(1/3^2 - 1/n^2)$. Measurements of hydrogen diffusion indicate transition temp. of the same type. These may be due to electronic shifts in the atoms, and H. and S. suggest that series transitions of this type may be present in solid manganese, and may be responsible for the discrepancies between the results of different investigators for some of the transition temp. Changes of this kind may be distinct from phase changes. In reply to *M. B. Bever*, P. and L. state that they found fused quartz preferable to alundum crucibles for melting manganese. *F. T. Worrell* shows a photograph of twins in a copper–manganese alloy, and suggests that γ-manganese may be face-centred cubic and not face-centred tetragonal; the latter may be due to strains in quenching.—W. H.-R.

Discussion on [R. M. Parke and J. L. Ham's Paper :] "The Melting of Molybdenum in the Vacuum Arc." —— (*Metals Technol.*, 1947, **14**, (4); *A.I.M.M.E. Tech. Publ.* No. **2187**, 11–14).—Cf. *Met. Abs.*, 1947, **14**, 2. *W. J. Kroll* and *A. W. Schlechten* refer to earlier papers on melting in the vacuum arc. They emphasize the difficulties likely to arise from vaporization of metal, and from gas discharge from residual gas in the metal. They found difficulty in maintaining a steady A.C. arc, and were forced to use D.C.; it might be possible to superimpose D.C. on A.C. P. and H. in reply state that vaporization difficulties were not encountered with molybdenum, but might be expected with relatively volatile metals such as chromium or manganese. So long as a sufficient c.d. was maintained, they found the A.C. arc very steady. In reply to *G. F. Comstock* and *R. S. Dean*, P. and H. state that with new types of vacuum pumps, the required degree of evacuation could be obtained. —W. H.-R.

Viscosity of Molten Aluminium and Its Alloys. (Akimow). See p. 99.

***Copper Oxidation Study Using Radio-Active Cu Tracer.** J. Bardeen, W. H. Brattain, and W. Shockley (*Bell Teleph. System, Tech. Publ.*, 1946, Monograph **B-1425**).—Reprinted from *J. Chem. Physics*, 1946, **14**, (12), 714–721; see *Met. Abs.*, 1947, **14**, 305.—J. L. T.

***Linear Casting Shrinkage of Gold and Its Alloys.** (Hollenback). See p. 104.

[**Discussion on E. A. Gulbransen and J. W. Hickman's Papers :**] "**Electron-Diffraction Study of Oxide Films on Iron, Cobalt, Nickel, Chromium, and Copper and Alloys at High Temperatures.**" (——) See p. 102.

Recent Developments and Prospects for the Future Regarding the Resistance of Materials. Ch. Massonnet (*Rev. Univ. Mines*, 1947, [ix], **3**, (4), 118–126). —A review.—M. E.

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

The Failure of Metals by Fatigue. J. Neill Greenwood (*Metallurgia*, 1947, **35**, (210), 289–290).—A general introduction to a symposium on the "Failure of Metals by Fatigue" held under the auspices of the Faculty of Engineering, University of Melbourne.—J. L. T.

Theories of the Mechanism of Fatigue Failure. W. Boas (*Metallurgia*, 1947, **35**, (210), 290–291).—A summary of a paper presented at the symposium on the "Failure of Metals by Fatigue" held under the auspices of the Faculty of Engineering, University of Melbourne.—J. L. T.

Fatigue Problems Associated with Aircraft Materials. H. Sutton (*Metallurgia*, 1947, **35**, (210), 291–292).—A summary of a paper presented at the symposium on the "Failure of Metals by Fatigue" held under the auspices of the Faculty of Engineering, University of Melbourne.—J. L. T.

[Discussion on J. H. Hollomon's Paper:] The Mechanical Equation of State. —— (*Metals Technol.*, 1947, **14**, (4); *A.I.M.M.E. Tech. Publ.* No. **2187**, 9–11).—Cf. *Met. Abs.*, 1947, **14**, 4. *J. H. Palm* and *A. V. Wijngaarden* summarize their work (*Metalen*, 1946, (Dec.)) which leads to H.'s equation. *D. J. McAdam* emphasizes that softening of a metal after cold work can take place at temp. well below that of recrystallization. H. agrees, and considers that the concept of a mechanical equation of state does not preclude the possibility that the stress may be differently dependent on strain at different temp. or rates of strain.—W. H.-R.

***Surface States and Rectification at a Metal–Semi-Conductor Contact.** John Bardeen (*Phys. Rev.*, 1947, [ii], **71**, (10), 717–727).—Theoretical. The condition of affairs at the interface between a metal and a semi-conductor is discussed. The previous theory regarded impurity atoms as giving rise to new energy levels in the forbidden region between the filled and conduction bands of a semi-conductor. This view is extended to take into account localized states on the surface with energies in the forbidden region. A condition of no net charge on the surface may correspond to a partial filling of these states. If the density of surface levels is sufficiently high, there will be an appreciable double layer at the free surface of a semi-conductor formed from a net charge from electrons in surface states and a space charge of opposite sign, similar to that of a rectifying junction, extending into the semi-conductor. This double layer tends to make the work function independent of the height of the Fermi level in the interior which in turn depends on the impurity content. If contact is made with a metal, the difference in work function between metal and semi-conductor is compensated by surface-states charge rather than by a space charge as is ordinarily assumed, so that the space-charge layer is independent of the metal. Rectification characteristics are then independent of the metal. These ideas are used to discuss conflicting experimental data.

—W. H.-R.

***Contact Potential Difference in Silicon Crystal Rectifiers.** Walter E. Meyerhof (*Phys. Rev.*, 1947, [ii], **71**, (10), 727–735).—Cf. preceding abstract. The rectifying portion of a crystal rectifier is the contact between a small point of metal such as tungsten, and a semi-conductor such as silicon containing suitable impurities. The potential energy characteristics of such contacts are reviewed, and the usual theory described. The contact p.d. between n and p types of silicon and different metals were measured experimentally by a method (Stephens, Serin, and Meyerhof, *Phys. Rev.*, 1946, [ii], **69**, 42, 244; see *Met. Abs.*, 1946, **13**, 158) in which the zero voltage resistance of the contact is measured as a function of the temp. The contact p.d. values were practically independent of the kind of metal used, and of the structure of the silicon surface. The work-function differences between the same substances were obtained independently by a parallel-plate condenser (Kelvin) method, using surfaces prepared under various conditions as regards exposure to the atmosphere. The results showed no correlation between the contact p.d. and

work-function-difference values. This is in contrast to accepted theory, and the reasons for this are discussed.—W. H.-R.

***The *K* X-Ray Absorption Edge of Silicon.** Vola P. Barton and George A. Lindsay (*Phys. Rev.*, 1947, [ii], **71**, (7), 406–408).

Erratum : The *K* X-Ray Absorption Edge of Silicon. Vola P. Barton and George A. Lindsay (*Phys. Rev.*, 1947, [ii], **71**, (10), 736–737).—A note making corrections to the authors' paper (see preceding reference).—W. H.-R.

***The Magnetic Quenching of Supraconductivity.** J. W. Stout (*Phys. Rev.*, 1947, [ii], **71**, (10), 741).—A note. Sienko and Ogg (*Phys. Rev.*, 1947, [ii], **71**, 319; see *Met. Abs.*, 1947, **14**, 310) suggested that for the "soft" supraconductors lead, mercury, tin, indium, thallium, CuS, Au_2Bi, zinc, and cadmium, the threshold magnetic field H_T for the destruction of supraconductivity is better represented by the expression $H_T = A(T_c^{3/2} - T^{3/2})$ than by the parabolic relation $H_T = B(T_c^2 - T^2)$. T_c is the temp. at which the metal becomes supraconducting in zero field. Systematic examination of the most accurate data shows that neither relation exactly fits the data, and that the parabolic relation is in all cases the better approximation.—W. H.-R.

For *A.S.T.M. Standards*, see pp. 124–129.

II.—PROPERTIES OF ALLOYS

Viscosity of Molten Aluminium and Its Alloys. G. Akimow (*Metal Progress*, 1946, **49**, (1), 99–100).—The viscosity of molten aluminium and of certain aluminium–silicon and aluminium–copper alloys has been investigated by Sergeiev and Polack by observations of the damping effects of the molten materials on the torsional oscillation of a steel ball suspended in the melt. The ball and pivot were protected by a refractory coating. Data obtained at 1290° F. (699° C.) for aluminium–silicon alloys and at 1255° F. (680° C.) for aluminium–copper alloys are summarized graphically, portions of the respective constitutional diagrams being reproduced for comparison. The viscosity in both cases increases sharply as the second component in the alloy first appears, and decreases considerably at eutectic composition. The discrepancy between these results and those of Sauerwald may be explained by the fact that S. measured the viscosity at temp. well above the liquidus.
—P. R.

***Room-Temperature Tensile Properties of Aluminium Alloy Sheet Following Brief Elevated-Temperature Exposure.** J. T. Lapsley, A. E. Flanigan, W. F. Harper, and J. E. Dorn (*J. Aeronaut. Sci.*, 1947, **14**, (3), 148–154).—Naturally aged materials 24S-T, 24S-RT, and 61S-W may be exposed (without deformation) for 20 min. at temp. up to 500° F. (260 C.) with little or no loss in yield stress. The artificially aged materials 24S-T81, 24S-T84, 24S-T86, 61S-T, R301-T, and XB75S-T may be similarly exposed without loss in yield stress at temp. up to 400° F. (205° C.), but above 450° F. (233° C.) the loss becomes great. Deformations involved in hot forming may induce an acceleration of the elevated-temp. ageing process.—H. Pl.

[Discussion on A. E. Flanigan, L. F. Tedsen, and J. E. Dorn's Paper :] "Stress-Rupture and Creep Tests on [Alclad] Aluminium Alloy Sheet at Elevated Temperatures." —— (*Metals Technol.*, 1947, **14**, (4); *A.I.M.M.E. Tech. Publ.* No. **2187**, 7–8).—Cf. *Met. Abs.*, 1947, **14**, 5. In reply to *J. C. McDonald*, the authors state that elongations at fracture in short-time tensile tests tended to be greater than elongations at fracture in stress-to-rupture tests. In reply to *K. R. van Horn*, they say that extrapolation of short-time creep data would seem hazardous.—W. H.-R.

***Brittle Failure of Hogged-Out Fittings from 14S-T Billets.** Given Brewer and Herman C. Ihsen (*Metal Progress*, 1946, **49**, (3), 566–571).—An account is given of failure in a large aircraft fitting hogged-out from 14S-T billet for experimental purposes, parts actually put into service being normally drop forged. Failure at a very low tensile stress occurred in one of the lugs, and observations of stress distribution on a photo-elastic model showed a marked difference between the actual distribution and that assumed for ductile material. Tests of pieces of the same shape as the lug again showed an unexpectedly low breaking stress, while similar pieces in 24S-T showed satisfactory properties in tension and a higher shear strength than was predicted. Measurements of stress distribution by means of photo-grids suggested that standard testing methods did not satisfactorily discriminate between satisfactory and poor material. Tests were then carried out on tensile pieces with a central round hole, the results corresponding fairly with those suggested by the stress distribution. Similar tests on billets which were upset before drawing showed a considerable improvement in properties. It is concluded that (*a*) notch-sensitiveness can be satisfactorily detected by using holed test-pieces, (*b*) billets for hogging-out should be upset and drawn at forging temp. before being machined. It is noted that 14S-T in extruded or plate form does not show similar notch-sensitiveness.—P. R.

[Discussion on A. H. Geisler and F. Keller's Paper :] "Precipitation in Age-Hardened Aluminium Alloys." (——) See p. 102.

[Discussion on A. D. Smigelskas and E. O. Kirkendall's Paper :] "Zinc Diffusion in Alpha Brass." —— (*Metals Technol.*, 1947, **14**, (4); *A.I.M.M.E. Tech. Publ.* No. **2187**, 15–22).—Cf. *Met. Abs.*, 1947, **14**, 94. *R. Smoluchowski* regards S. and K.'s results as evidence for the existence of lattice defects and vacancies, and is surprised that the influence of vacancies is so large. *R. F. Mehl* discusses the bearing of the results on the general theory of diffusion. *C. S. Smith* suggests that the changes in composition resulting from diffusion set up strains on account of changes in lattice spacing. These strains may be relieved by the formation of cracks or fissures through which zinc may pass by vaporization, and this may account for an apparent diffusion of zinc greater than that of copper. *L. S. Darken* points out that in the formation of oxide scales, it has already been recognized that the mobilities of anion and cation are not equal. He also develops the activity theory of diffusion. *E. W. Palmer* raises the possibility of the results being affected by oxidation, and *M. R. Herman* states that results similar to those of S. and K. have been observed in the study of diffusion in α aluminium bronzes. E. O. K. replies to the discussion, and thinks it improbable that the results were affected by oxidation.—W. H.-R.

***Constitution of the System Indium–Tin.** F. N. Rhines, W. M. Urquhart, and H. R. Hoge (*Trans. Amer. Soc. Metals*, 1947, **39**, 694–711; discussion, 711–712).—The liquidus was determined from cooling curves and the solidus by observing the temp. at which a lightly loaded test specimen ruptured during slow heating. Metallographic observations were made on specimens cut with a razor blade, ground with 600 carborundum in soap solution on broad-cloth, polished with alumina in soap solution on silk nap cloth, and etched in a solution of 6 g. K_2CrO_7 in H_2SO_4 20, saturated NaCl solution 12, HF 80, HNO_3 40, and water 300 c.c. In general, the diagram of Fink, Jette, Katz, and Schnettler (*Trans. Electrochem. Soc.*, 1939, **75**, 463; see *Met. Abs.*, 1939, **6**, 403) is confirmed, but it is considered that the γ-phase undergoes peritectoid decomposition below 80° C. and not peritectic decomposition at 124° C. The limits of the α- and δ-phase fields are relocated. Resistance to compression is a well defined maximum near the limit of solid solubility of indium in tin.

—J. C. C.

[**Discussion on E. A. Gulbransen and J. W. Hickman's Papers :**] "**Electron-Diffraction Study of Oxide Films on Iron, Cobalt, Nickel, Chromium, and Copper and Alloys at High Temperatures.**" (——) See p. 102.

[**Discussion on R. S. Busk and E. G. Bobalek's Paper:**] "**Hydrogen in Magnesium Alloys.**" —— (*Metals Technol.*, 1947, **14**, (4); *A.I.M.M.E. Tech. Publ.* No. **2187**, 22–24).—Cf. *Met. Abs.*, 1947, **14**, 95. *L. A. Carapella* states that hydrogen could be removed more rapidly by vigorous mechanical stirring, or by vibration during high-frequency melting. In reply to questions, R. S. B. states that the role of hydrogen in magnesium alloys is that of aggravation of micro-shrinkage. As a void is formed on contraction of the solidifying liquid, hydrogen gas diffuses into the space, and so prevents more liquid from feeding the void. In reply to *L. C. Chang*, R. S. B. says that the solid solubility of hydrogen in magnesium is markedly affected by the presence of alloying elements, but no correlation with the Periodic Table could be found. *J. J. Naughton* raises the question of hydrogen embrittlement, and R. S. B. says that there was no evidence of hydrogen embrittlement of magnesium alloys.—W. H.-R.

[**Discussion on J. P. Doan and G. Ansel's Paper :**] "**Some Effects of Zirconium on Extrusion Properties [and Constitution] of Magnesium-Base Alloys Containing Zinc.**" —— (*Metals Technol.*, 1947, **14**, (4); *A.I.M.M.E. Tech. Publ.* No. **2187**, 24–25).—Cf. *Met. Abs.*, 1947, **15**, 199. In reply to *P. Gordon*, A. states that little is known about the characteristics of the zirconium phase present in the magnesium-rich alloys. The improvement in properties is due chiefly to grain refinement. *A. R. Kaufmann* raises the question of extrusion speed, and A. states that the effect of variations in this factor could be ascribed largely to the temp. developed. In reply to *A. V. Lorch*, A. says that there was no apparent effect of zirconium on the corrosion of magnesium–zirconium, or magnesium–zinc–zirconium alloys.—W. H.-R.

Nickel and High-Nickel Alloys. Norman E. Woldman (*Materials and Methods*, 1946, **24**, (6), 1475–1490).—A "materials and methods manual". A comprehensive summary is given of the properties of the commercially available forms of nickel and nickel alloys, with an account of preferred practices for heat-treating, welding, cleaning, finishing, and machining these materials.
—J. C. C.

Physical Metallurgy of Precious-Metal Alloys. (Wise). See p. 105.

Development of Silver Alloys with Specialized Physical Characteristics. (Shell). See p. 105.

Super Alloys for High-Temperature Service. H. A. Knight (*Mécanique*, 1946, **30**, (337), 218–220).—From *Materials and Methods*, 1946, **23**, (6); see *Met. Abs.*, 1947, **14**, 200.—W. G. A.

Magnetic and Electrical Materials. Robert S. Burpo, Jr. (*Materials and Methods*, 1947, **26**, (2), 115, 117).—Engineering File Facts No. 146.—J. L. T.

A Periodic Chart for Metallurgists. Carl A. Zapffe (*Trans. Amer. Soc. Metals*, 1947, **38**, 239–265; discussion, 265–270).—The elements are arranged on a schematic representation of the electron shells of the heaviest element. The elements of atomic weight 89 and upwards (including the four newly discovered elements 93–96) are arranged as a second series of rare earths. The use of the chart to illustrate certain principles of alloy formation is discussed. —J. C. C.

For *A.S.T.M. Standards*, see pp. 124–129.

III.—STRUCTURE

(Metallography; Macrography; Crystal Structure.)

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

[Discussion on A. H. Geisler and F. Keller's Paper:] "Precipitation in Age-Hardened Aluminium Alloys." —— (*Metals Technol.*, 1947, **14**, (4); *A.I.M.M.E. Tech. Publ.* No. **2187**, 8–9).—Cf. *Met. Abs.*, 1947, **14**, 97. In reply to *J. H. Hollomon*, G. and K. state that quenching of alloys produces plastic deformation, so that slip bands are visible on a polished surface, and these may act as sites for localized precipitation in the early stages of ageing. The effect is not observed with slower rates of cooling. *A. S. Coffinberry* questions the use of the electron microscope for detecting localized precipitation, and G. replies that the ordinary light microscope will supply evidence of localized precipitation more readily than the electron microscope because a large area must be scanned. The electron microscope will resolve particles which are too small for the ordinary microscope.—W. H.-R.

[Discussion on E. A. Gulbransen and J. W. Hickman's Papers:] "Electron-Diffraction Study of Oxide Films on Iron, Cobalt, Nickel, Chromium, and Copper and Alloys at High Temperatures." —— (*Metals Technol.*, 1947, **14**, (4); *A.I.M.M.E. Tech. Publ.* No. **2187**, 25–37).—Cf. *Met. Abs.*, 1947, **14**, 98. *P. K. Koh* refers to the effect of thermal expansion on the measured lattice spacings, and, after replying, G. reproduces a graph showing the reduced lattice constants of the oxides in iron scale as a function of the oxygen content. *R. F. Mehl* discusses the orientation and rate of growth of films. In reply to *C. G. Goetzel*, G. describes and illustrates the electron-diffraction camera high-temp. furnace. *C. H. Samans* states that results for the oxidation of stellite in air at 900°–1100° C. did not agree with those obtained under the conditions used by G. and H., and reasons for this are discussed. *A. R. Bobrowsky* questions the sensitivity of the electron-diffraction methods for detecting small percentages of one oxide in the presence of another. In reply to *Roger Sutton*, G. states that most of the oxides used would not be expected to decompose at the temp. and pressures concerned. *H. S. Avery* refers to Fe_3O_4 and the spinels, and emphasizes that many spinel compositions are possible. G. and H. discuss this, and describe electron-microscopic observations of the growth of films. *M. L. Fuller* refers to the possibility of false values being obtained for lattice spacings owing to the accumulation of positive charge on the specimen, with a resulting deflection of the diffracted electron beams. G. and H. agree with this, but show that the effect could not be responsible for the relatively large lattice spacings which they obtained. Variations in the compositions of different specimens might account for the conflicting lattice spacings. *U. R. Evans* agrees that departure from stoichiometrical equivalence often occurs. He then describes experiments on the stripping of films from oxidized surfaces; these films were often wrinkled or curved, suggesting the presence of stresses which would affect the lattice spacings. *A. G. Quarrell* emphasizes that the relatively slight differences between the lattice spacings of different spinels limits the use of electron-diffraction methods for identifying substances in the film. He also discusses the protective mechanism.—W. H.-R.

[Discussion on C. S. Barrett and C. T. Haller's Paper:] "Twinning in Polycrystalline Magnesium [Alloys]." —— (*Metals Technol.*, 1947, **14**, (4); *A.I.M.M.E. Tech. Publ.* No. **2187**, 1–7).—Cf. *Met. Abs.*, 1947, **14**, 202. *R. L. Dietrich* summarizes previous work, and states that the deformation of polycrystalline magnesium alloys is not completely explained by work on single

crystals. He agrees with B. and H. that {101} slip is active at room temp., and shows an example of a banded structure. *K. Jetter* illustrates banded structures produced by bending; these are outcrops of regions where localized as a result of re-orientation resulting from {102} twinning. Banded structures and other examples of localized deformation produced in rolling are illustrated and discussed. B. and H. consider that further evidence is needed before twinning is definitely established as responsible for these structures. *G. Ansel* enquires whether the decrease in tensile yield strength occurring in the roller-levelling process is the result of re-twinning of material twinned during roller-levelling, and B. and H. agree that this is probable. G. shows new pole figures for material subjected to compression.—W. H.-R.

***Some Special Metallographic Techniques for Magnesium Alloys.** P. F. George (*Trans. Amer. Soc. Metals*, 1947, **38**, 686–708; discussion, 708; and (summary) *Aluminum and Magnesium*, 1947, **3**, (5), 11–13, 24–25).—Special etching solutions are freshly made up from I, 5 g. of picric acid dissolved in ethanol to make 100 c.c.; II, glacial acetic acid; III, conc. nitric acid; IV, 48% hydrofluoric acid; and V, distilled water. A mixture of I 50, V 20, and II 20 parts by vol., used for exactly 15 sec., forms an amorphous film on the polished surface of magnesium–aluminium–zinc solid-solution alloys within a restricted range of compositions, and a mixture I 50, V 20, and II 16 forms a similar film on alloys within a rather more extended range. The films, when dry, develop cracks parallel to the trace of the basal plane in each grain. These etchants may be used for revealing changes in composition within grains, for showing diffusion during heat-treatment, for distinguishing between micro-shrinkage and fusion voids, and for estimating the temp. at which some alloys have been aged. A mixture of I 100, II 5, and III 3 slows diffusion of aluminium from an aluminium-clad base metal to a manganese-containing cladding metal. A mixture of equal vol. of I and V gives great contrast between Mg_2Si (brilliant blue) and the manganese constituent (dull grey). A mixture of IV 10 and V 90 darkens $Mg_{17}Al_{12}$ compound and leaves $Mg_3Al_2Zn_3$ unetched and white; and if the specimen is then immersed in a mixture of I 10 and V 90, the matrix is stained a golden colour and $Mg_3Al_2Zn_3$ remains white. This procedure ensures that the ternary compound is not overlooked. Grain boundaries in cast alloys and those wrought alloys which are usually hard to etch may be revealed with a mixture of I 100, V 10, and II 5, which also differentiates between grains of various orientations and is very sensitive in revealing distortion. Good contrast between the two types of precipitate found in the magnesium–aluminium and magnesium–aluminium–zinc alloys is given by an etchant containing I 100 and V 10.—J. C. C.

Visual Aids in Teaching Metallography. J. O. Lord (*Machinery Lloyd*, 1946, **18**, (2), 67–69).—The American Society for Testing Materials sponsored a programme of research and experimentation in the development of motion pictures dealing with some of the elementary concepts of physical metallurgy. L. supervised the production of a motion picture entitled "Metal Crystals", which required 40 min. showing. He describes the difficulties encountered and the technique adopted in the production of this film.—H. Pl.

Metallography, Fatigue of Metals, and Conventional Stress Analysis. H. G. Moore (*Metallurgia*, 1947, **35**, (210), 290).—A summary of a paper presented at the symposium on the "Failure of Metals by Fatigue" held under the auspices of the Faculty of Engineering, University of Melbourne, Australia.—J. L. T.

Fractography. —— (*Machinery Lloyd*, 1946, **18**, (4), 81).—"Fractography" is described as a new metallurgical technique for studying fractures in metals. Two main operations are carried out; first, an individual facet is selected for examination by the aid of a magnifying glass; second, the specimen is mounted between clamps at right angles to the axis of the microscope by means of a simple orienting mechanism. Neither polishing

nor etching is performed, the actual plane of weakness being the only surface examined.—H. Pl.

The National Physical Laboratory [Use of Electron Microscope]. —— (*Machinery Lloyd*, 1946, **18**, (15), 82–83).—Reference is made to the use of the electron microscope in the metallurgical laboratory. By indirect methods, magnifications up to 10,000 dia. have been obtained which are superior in definition to those obtained in optical microscopes at a magnification of 1000 dia.—H. Pl.

Direct Determination of Stacking Disorder in Layer Structures. W. H. Zachariasen (*Phys. Rev.*, 1947, [ii], **71**, (10), 715–717).—Theoretical. Irregularities in the relative displacement of the layers parallel to their own planes occur in many crystals of the layer-structure type. This stacking disorder gives rise to characteristic features in the X-ray and electron-diffraction patterns of such crystals. A stack of N identical, parallel, and equi-distant layers is used as a simple model; irregularities in the relative displacements parallel to the plane of the layers correspond to stacking disorder. It is shown that X-ray diffraction data permit a direct determination of the Fourier coeff. of the functions which describe the stacking disorder.—W. H.-R.

For *A.S.T.M. Standards*, see pp. 126, 130.

IV.—DENTAL METALLURGY

The Use of Base-Metal Alloys in Casting. Paul Collins (*J. Dental Research*, 1946, **25**, (3), 158).—Summary of a paper presented to the International Association for Dental Research. The development of industrial casting practices based on the lost-wax method common in dentistry, and the extent of the application in industry, are described. The nature of the investment used for casting Vitallium-type alloys for supercharger buckets and other aircraft-engine parts are discussed. Practice and experience gained from dental casting practices were of value to the industrialist. In like manner it is expected that added information gained by industrial research during recent years will be of importance in the future improvement of design and soundness of quality dental structures.—Author.

Developments in Investments for the Casting of Gold Alloys and Base Metals. T. E. Moore (*J. Dental Research*, 1946, **25**, (3), 158).—Summary of a paper presented to the International Association for Dental Research. The composition and physical and chemical properties of the various investment types that are used in dentistry to make inlays and partial-denture castings of gold and base-metal alloys are discussed. The application of the dental investments and the lost-wax process to industrial use for casting critical war parts of high-m.p. chromium alloys is also described. New investments and processes that were developed and used during the war are reviewed.—Author.

***A Study of Investment Expansions Required for Gold Inlay Castings.** Claude Watts (*J. Dental Research*, 1946, **25**, (3), 160).—Summary of a paper presented to the International Association for Dental Research. This is a preliminary report giving the results of expansion tests on an investment material and includes data on thermal expansion, setting expansion, and hygroscopic expansion. A comparison of results obtained by two different methods of determining setting expansion is made. Consideration is given to the effect of the shape of the wax pattern on the investment expansion. Results of experimental tests on inlay castings are given, correlating such factors as type of inlay gold, total investment expansion, and fit of the casting.—Author.

***Linear Casting Shrinkage of Gold and Its Alloys.** George M. Hollenback (*J. Dental Research*, 1946, **25**, (3), 159).—Summary of a paper presented to the International Association for Dental Research. The linear casting

shrinkage of gold was established as 1·65%±0·03%; previously, the accepted figure had been 1·25%. Alloying metals reduce the shrinkage considerably, but the reduction is not proportional to the percentage of the alloying metal; the effect of different metals should be investigated.—J. L. T.

***Effects of Variation in the Mercury : Alloy Ratio Upon the Amalgam Filling.** Ralph W. Phillips (*J. Dental Research*, 1946, **25**, (3), 183).—Summary of a paper presented to the International Association for Dental Research. The purpose of the investigation was to determine the importance of strict adherence to the recommended ratio of mercury and alloy in the manipulation of dental amalgam. Six alloys of varying grain-size were used and three different mercury : alloy ratios : (1) 15% less mercury than recommended, (2) recommended ratio, and (3) 15% more mercury than recommended. The percentage of residual mercury was determined in each case, and the physical properties tested.—J. L. T.

Physical Metallurgy of Precious-Metal Alloys. E. M. Wise (*J. Dental Research*, 1946, **25**, (3), 159).—Summary of a paper presented to the International Association for Dental Research. Discussion is given of the properties of the individual precious metals and the systems gold–silver–copper, palladium–silver–copper, as well as the more complicated alloys containing platinum and palladium derived from these systems, which are the basis for the alloys broadly employed in dentistry. Precious-metal alloys having higher m.p. are also described. Attention is given to some of the precipitation-hardening transformations and the melting behaviour of dental alloys. —Author.

***Effects of Heat-Treating [Silver-] Amalgam Alloy Ingots Before Cutting Into Filings.** K. W. Ray (*J. Dental Research*, 1946, **25**, (3), 159).—Summary of a paper presented to the International Association for Dental Research. Variation in heat-treatment of silver-amalgam alloy ingots before they are cut into filings can alter the properties of the amalgam made from the filings considerably if the alloy contains 70% silver; but in an alloy containing 68% silver the properties are not affected.—J. L. T.

Development of Silver Alloys with Specialized Physical Characteristics. John Shell (*J. Dental Research*, 1946, **25**, (3), 160).—Summary of a paper presented to the International Association for Dental Research. During the last ten years, numerous rather complicated and unusual alloys of silver have been employed for specific industrial uses. The requirements may vary from a high electrical conductivity to a high tensile strength. Silver as a basis for such alloys has been found to contribute remarkable properties not generally attainable by the use of any other metal.—Author.

V.—POWDER METALLURGY

The Use of Ultra-Fine [Copper] Particles in Powder Metallurgy. Henry H. Hausner (*Materials and Methods*, 1946, **24**, (1), 98–102; also (summary) *Metallurgia*, 1947, **35**, (210), 315–316; and *Mécanique*, 1946, **30**, (339), 283).—The use of a new type of fine copper powder, having an average dia. of 2 μ and more uniform than " −325 mesh " powder, is discussed. Used alone, it gives high densities with low compacting pressures. Mixtures with coarser copper, tin, or tungsten powders flow well and give the highest densities with high compacting pressures.—J. C. C.

Heavy Alloy. G. H. S. Price (*Indian Eng.*, 1947, **121**, (1), 42–43).—P. describes a " heavy alloy " developed by the General Electric Company, Ltd. It is a product of powder metallurgy containing 90% tungsten with nickel and copper. The alloy can be machined, punched, and drilled with ease, and has a tensile strength of 42 tons/in.^{2}, yield point of 38 tons/in.^{2}, com-

pressive strength of over 130 tons/in.^{2}, and an elongation of 3%. The alloy, which is twice as heavy as steel, has a modulus of elasticity of 32×10^6 lb./in.^{2} and a Brinell hardness of 290. It has been used in aircraft for flight-control surfaces and crankshafts, as well as in gyroscopes and gyro-compasses. It is an ideal material for arcing contacts of oil-immersed heavy-current circuit breakers.—S. K. G.

Powdered Metal *vs.* Other High-Production Methods. Herbert Chase (*Materials and Methods*, 1946, **24**, (2), 363–369).—Powder-metallurgy products can be made in sizes up to about 8 in.^{2} in cross-sectional area and 3 in. high, with some limitations on shape, with little labour and negligible scrap loss to reasonable dimensional tolerances. Surfaces are smooth and it is possible to incorporate inserts. Comparisons are drawn with products formed by sand- or die-casting, stamping, or machining.—J. C. C.

Powder Metallurgy: The Key to High-Temperature Power Applications. —— (*Machinery Lloyd*, 1946, **18**, (4), 95).—A review of the research projects of the American Electro-Metal Corporation is given which includes (1) finding a combination of refractory metals and refractory ceramics which will resist high temp., (2) the combining of metals and plastics so as to lend the strength of the metals to the mixture, (3) the development of high-strength alloy-steel parts for quantity production through powder metallurgy. "Sinteel G" is one of the firm's products; this is a 100%-dense "bronze", produced by infiltrating molten copper into porous steel.—H. Pl.

Some Aspects of the Problem of Powder Metallurgy. A. Martigny (*Usine Nouvelle*, 1947, **3**, (34), 12; (35), 12).—A review of recent technical advances in the manufacture and usage of metallic powders.—J. L. T.

Extruding Powdered Metals to Form Synthetic Welding Wires. F. G. Daveler (*Machinery Lloyd*, 1946, **18**, (26), 86–89).—An alloy welding rod composed of drawn wire clad with alloying elements has been produced by powder-metallurgy methods. The production of this new-type wire has paved the way for development of a method of extruding powdered metals and compacting them around a wire, emphasis being placed on control of particle size and selection of a suitable lubricant.—H. Pl.

New Ceramic Combines Ceramic Materials and Powdered Metals. Henry H. Hausner (*Ceram. Ind.*, 1946, **47**, (4), 87–105; (5), 90–96).—A discussion of the procedures applied in powder metallurgy and ceramic practice. H. compares these processes and the materials employed in each field, and suggests that the way is open for new ceramic–metal products. A few examples, illustrated with photomicrographs of compound materials, are given.—J. S.

For *A.S.T.M. Standards*, see p. 130.

VI.—CORROSION AND RELATED PHENOMENA

Corrosion of Light Alloys. —— (*Metal Progress*, 1946, **49**, (5), 1028, 1030, 1032, 1034).—A summary of German work published in *Korrosion u. Metallschutz* and *Aluminium* in 1943 and 1944. Stress-corrosion of aluminium-rich aluminium–zinc–magnesium forging alloys containing over 5% zinc and magnesium together, has been found by German workers to depend on quenching temp. as well as on conditions after homogenization. The effect of reducing quenching temp. for cold-worked and quench-hardened alloys to just below solution temp. was observed under different conditions of exposure, cooling, and ageing. Stress-corrosion in specimens aged at room temp. and at high temp. improved at the expense of mechanical properties, but air-cooled specimens remained superior. Water-quenched and subsequently age-hardened samples showed increased sensitivity to stress-corrosion after annealing at 175°–265° F. (80°–130° C.); improved resistance was conferred

by water-quenching from 715° F. (380° C.) and normalizing at 212° F. (100° C.), but this did not apply to specimens aged for long periods. Structural deterioration of aluminium and magnesium by corrosion, as described by W. Patterson, depends both on the nature of the phases present (i.e. on the p.d. between them) and on the arrangement of the phases in the structure; secondary constituents less "noble" than the matrix will be dissolved out, further penetration then depending on the properties of the matrix. If the latter is the less "noble", it will be attacked at the boundaries between phases, and graining and pitting will result. A 2-phase structure with a definite phase arrangement is regarded as an essential condition for corrosive deterioration in light alloys, the presence of certain phases usually indicating instability. Factors in "layer" corrosion, intercrystalline corrosion, and weld cracking are reviewed, the diminished weld cracking of magnesium–manganese–cerium alloys after additions of aluminium being associated with the form in which $CeMg_9$ and $CeAl_2$ respectively are deposited at the grain boundaries.—P. R.

Developments in Corrosion Studies and Corrosion Control. H. M. Olson (*Iron Steel Eng.*, 1946, **23**, (1), 80–95).—A review of American literature on corrosion (mainly water corrosion) and its prevention, covering the period 1935–45. A *bibliography* of 100 references is appended.—M. A. V.

Corrosion. M. G. Fontana (*Machinery Lloyd*, 1946, **18**, (14), 67–73; (17A), 37–41).—F. arbitrarily classifies corrosion into eight forms: (1) uniform attack, normally characterized by a chemical or electrochemical reaction; (2) pitting, very localized attack; (3) galvanic, which is not necessarily limited to direct contact of two dissimilar metals, but may occur in a system wherein a complete electric circuit exists; (4) dezincification, which can be checked for by the addition of certain alloying elements; (5) stress-corrosion, which is a function of stresses, temp., and concentration of corroding influence; "caustic embrittlement" and "season cracking" are examples; (6) erosion corrosion, which occurs frequently in pumps, valves, lines, centrifugals, &c.; (7) intergranular corrosion; and (8) concentration cell, which involves differences in environment, in contrast to the galvanic type. Mention is made of the work of the Corrosion Research Centre at the Ohio State University.

—H. PL.

For *A.S.T.M. Standards*, see pp. 126, 130.

VII.—PROTECTION

(Other than by Electrodeposition.)

The Alumilite Process. R. H. Pettit (*Modern Metals*, 1947, **3**, (7), 16–18).—The uses of the Alumilite (sulphuric acid anodizing) process are described, but no details of operation are given.—N. B. V.

Anodic Treatment for Aluminium-Base Alloys. (Chromic Acid Process.) —— (*Aeronaut. Material Specification* (*S.A.E.*), 1947, (**AMS 24,700**), 2 pp.).—A revised specification.

Developments in Tinplate Substitutes. —— (*Tin*, **1947**, (May), 22–23).—Although no electrolytic tinplate is as yet being manufactured in Great Britain, a large plant is in the course of erection in the works of Richard Thomas and Baldwin in South Wales. Other substitutes for tin, or hot-dipped tinplate, have not proved satisfactory.—J. S.

Actual State of Our Knowledge on the Brittleness of Galvanized Malleable Black-Heart Cast Iron. —— (*Fonderie*, 1947, (**13**), 487–495).—A review of the researches of W. R. Bean, H. Marshall, T. Kituka, and M. Leroyer. The cast iron is not brittle when its phosphorus content is less than 0·10%, or after heating for 30 hr. at 950° C. followed by 40 hr. at 670° C. and quenching in water.—M. E.

Flame Spraying. P. G. Clements (*Machinery Lloyd*, 1946, **18**, (14), 84–85; (21A), 53–55).—The Schori metal-powder pistol is used for spraying protective zinc and decorative bronze coatings. Usually zinc is sprayed to a thickness of 0·003 in. at the rate of 250 ft.^{2}/hr. The sprayed coating is less brittle and much thicker than the old galvanized coating.—H. Pl.

Protection by Means of Metallic Deposits. J. Kamecki (*Hutnik*, 1946, **13**, 70–82).—[In Polish]. Different methods of depositing tin and zinc on metals are discussed.—W. J. W.

Protective and Decorative Finishes. I.—Protective Chemical Methods and Pre-Treatment of Metals. R. E. Blakey (*Machinery Lloyd*, 1946, **18**, (13), 67–76).—Treatments of the simple inversion type for copper, copper alloys, aluminium alloys, zinc-base alloys, and magnesium alloys are described. Electrodeposited coatings and sources of corrosion troubles are dealt with. The M.B.V. process for aluminium alloys gives an excellent basis for paints, but the E.W. process produces a film which gives a higher degree of corrosion protection. Aluminium anodizing treatments, including the Bengough–Stuart and sulphuric acid processes, are also reviewed.—H. Pl.

Paint Research Station Investigates Raw Material. L. A. Jordan (*Board of Trade J.*, 1947, **153**, (2648), 1630–1631).—A brief survey of progress in the manufacture of paints, and their use in protecting metal surfaces from corrosion.—J. L. T.

Treatments for Metal Surfaces Prior to Painting. E. F. Hickson and W. C. Porter (*Product Eng.*, 1947, **18**, (8), 128–130).—A summary of standard practice in the treatment of metal surfaces, ferrous and non-ferrous.—H. V.

For *A.S.T.M. Standards*, see pp. 126, 128, 130.

VIII.—ELECTRODEPOSITION

***Measurement of Embrittlement During Chromium and Cadmium Electroplating and the Nature of Recovery of Plated Articles.** Carl A. Zapffe and M. Eleanor Haslem (*Trans. Amer. Soc. Metals*, 1947, **39**, 241–258; discussion, 258–260).—The hydrogen embrittlement produced in annealed and cold-drawn wires of AISI 440-C 17% chromium stainless-steel wire by chromium plating is, unexpectedly, much more severe than that produced by straight cathodic pickling at the same temp. and c.d. In cadmium plating also, in which only about 10% of the current is utilized in liberating hydrogen, the embrittlement is greater than that produced by cathodic pickling. Embrittlement was measured by a reverse-bend test. Chromium-plated specimens carrying a light deposit and cadmium-plated specimens recover ductility on heating at 100° C. In this operation, an initial recovery is followed by an "ageing relapse", when recovery is suspended (and a temporary increase in brittleness may occur) due to redistribution of hydrogen between core and coating. On further heating, recovery proceeds to finality. Heating in aqueous solutions appears to be considerably more effective in removing hydrogen than heating in oil or argon. With thick chromium deposits, only partial recovery can be effected by heating at 100° C. Even at 300° C. recovery is incomplete; and although the original bend values are obtained after heating at 400° C., the structure of the steel core and coating are affected.—J. C. C.

Chromium Plating of Cylinder Bores and Piston Rings. E. V. Paterson (*Machinery Lloyd*, 1946, **18**, (3), 67–70).—The Van der Horst method of porous chromium plating has considerably increased the life of cylinder liners. In the case of one medium-sized Diesel engine of 400/600 mm. bore with chromium-plated liners, wear averaged only 0·0002 in. per 1000 running hr. Porosity is obtained by a current-reversing treatment, and it is possible to obtain a 40%-porous surface. A minimum plating thickness of 0·0005 in. is

recommended. Some good results have been secured by chromium-plating piston rings, but it is definitely not advantageous to employ chromium-plated rings with a chromium-plated bore.—H. PL.

Hard Chromium Plate and Its Uses. J. M. Hosdowich (*Materials and Methods*, 1946, **24**, (4), 896–900; correspondence, (6), 1493–1494).—Uses of thick electrodeposits of chromium are listed.—J. C. C.

Chromium Plating, Hard. —— (*Aeronaut. Material Specification* (*S.A.E.*), 1947, (**AMS 2406**), 3 pp.).—Specifications for chromium plating on ferrous materials to increase abrasion resistance are given.—J. L. T.

***Determination of the Thickness of Chromium Deposits on Nickel by the Drop Test.** E. S. Spencer-Timms (*Galvano*, 1947, **16**, (127), 7–10).—Translated from *J. Electrodepositors' Tech. Soc.*, 1946, **21**, 79–90; see *Met. Abs.*, 1947, **14**, 112.—J. L. T.

Copper Plate as a Stop-Off When Nitriding. W. V. Sternberger and E. R. Fahy (*Metal Progess*, 1946, **50**, (4), 673).—Stress is laid on the importance of the type of copper deposit used as a mask in nitriding if the cycle is relatively long; the experience of C. J. Miller to the opposite effect was derived from a 65-hr. cycle only. The effect of sand blasting was to increase the depth of coating needed for protection rather than to improve the uniformity of plating.—P. R.

[**Production of**] **Ultra-Thin Nickel Ribbons** [**for Use in Bolometers**]. Frank G. Brockman (*Metal Progress*, 1946, **49**, (6), 1172).—Thin ribbons of nickel have been produced by electrodepositing nickel on copper foil from a nickel sulphate + ammonium chloride + boric acid bath, shearing the foil into ribbons of the required dimensions, attaching these to a frame of platinum wire, and dissolving the copper electrochemically in a cyanide bath. The ribbons, which may be only 0·1 μ thick, are used as sensitive filaments in bolometers (for the measurement of minute quantities of radiant heat, e.g. in astronomy and spectroscopy).—P. R.

Tin Plating. —— (*Aeronaut. Material Specification* (*S.A.E.*), 1946, (**AMS 2408**), 2 pp.).

Has Electrolytic Tinplate Come to Stay in the U.S.A.? —— (*Tin*, **1947**, (Mar.), 20).—The development of the technique during the war of electrodepositing tin at high speeds and high c.d. resulted in the establishment in the U.S.A. of large plants for the manufacture of electro-tinplate. Constructed originally with an eye on a possible scarcity in tin, these plants to-day supply electrolytic tinplate to a widening market. While hot-dipped tinplate holds almost the whole market in Great Britain, in America the percentage of electrolytic to hot-dipped tinplate was 47% in 1946. A revised conservation order permitting a wider scope for electrolytic tinplate than before is another sign that it has come to stay in the U.S.A.—J. S.

Continuous Electro-Zinc Plating. —— (*Machinery Lloyd*, 1946, **18**, (3), 88).—Zinc can be deposited on continuous strips of steel up to 38 in. in width at a speed of 160 ft./min.—H. PL.

Abstracts of Papers Presented at the 33rd Annual Convention of the A.E.S. —— (*Monthly Rev. Amer. Electroplaters' Soc.*, 1946, **33**, (7), 707–711, 745).—Abstracts of these papers are given: *William Blum*, "Wartime Activities on Plating at the National Bureau of Standards"; *Abner Brenner* and *Grace E. Riddell*, "Nickel Plating on Steel by Chemical Reduction"; *Abner Brenner* and *Walter A. Olson*, "Purification of Rhodium-Plating Baths"; *J. Edward Bemiller*, "Corronizing Wire Screen Cloth Using Radiant Heating"; *Theodore Voyda*, "X-Ray Diffraction Studies of Electrodeposits"; *Paul R. Cutter*, "Manodyzing and Dye-Colouring Magnesium Alloys"; *George Shore*, "Plating with Acid Copper Solution"; *A. W. Hothersall*, "Review of Developments in Electroplating in Great Britain During the War"; *C. J.*

Lewis, "Disposal of Plating-Room Waste Liquors in Compliance with Stream-Pollution Laws"; *Van M. Darsey*, "Effect of Surface Preparation on the Durability of Organic Coatings"; *F. L. Scott*, "Resins of the Vinyl Family in Metal Finishing"; *C. W. Smith*, "Examination of Electro-Cleaned Steel by the Electron-Diffraction Technique".—J. L. T.

Technical Advances in Electroplating. Allen G. Gray (*Steel*, 1946, **119**, (2), 102–104, 106, 108).—A summary of the proceedings of the 1946 Convention of the American Electroplaters' Society.—M. A. V.

Electroplating by Brush. —— (*Metal Finishing*, 1947, **45**, (9), 84).—Engineering data sheet.—J. L. T.

Precision Metal Parts Produced by Electroforming. H. R. Clauser (*Materials and Methods*, 1946, **24**, (1), 112–116).—Parts up to ½ in. thick are produced by electrodeposition of iron, copper, or nickel on a matrix made from either a bismuth–lead type of alloy of low m.p., a steel mandrel coated with a parting compound (of tin, cadmium, wax, or lacquer), or from a metal such as aluminium, zinc, or magnesium that can subsequently be dissolved. The products have an exceptionally high surface finish and can be made in intricate shapes to close dimensional tolerances (±0·0002 in.). Some applications are described.—J. C. C.

For *A.S.T.M. Standards*, see p. 130.

XI.—ANALYSIS

Distinguishing the Common Aluminium Alloys. Frank C. Bennett, Jr. (*Metal Progress*, 1946, **50**, (4), 659, 661).—Characteristic ingredients in certain light alloys can be detected, and in some cases the group of alloy identified, by simple chemical tests. Mn in 17S and 24S is detected by treatment with conc. HNO_3 and a little sodium bismuthate after the detection of Cu with NaOH, the excess NaOH being removed by gentle washing; a purple colour is produced, while the Mn-free 11S gives no colour. Alloy 3S, which does not contain Cu, is not blackened by NaOH but gives the purple coloration if Mn is present. Successive treatment with conc. HCl, 20% H_2SO_4, phenol in glacial acetic acid, and *s*-diphenylcarbazide under stated conditions produces a characteristic rose colour with 52S, 53S, and 61S.—P. R.

Rapid Method for the Determination of Total Platinum Metals. V. M. Mukhachev (*Zavod. Lab.*, 1946, **12**, (11/12), 927–929.—[In Russian]. A method is proposed for the separation of the Pt metals from a solution of a 3-mm.-dia. Cu wire.—N. A.

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

A New Portable Hardness Tester. —— (*Indust. Diamond Rev.*, 1947, [N.S.], **7**, (82), 266).—A description of a new hardness tester employing a 136° diamond pyramid. The specimen is gripped in a vice and the load applied hydraulically; the indentation is measured with a microscope.—R. W. R.

Hardness-Testing Method for Small Cylindrical Work-Pieces. M. C. Attinger (*Indust. Diamond Rev.*, 1947, [N.S.], **7**, (82), 264–265).—A translation of *Bull. Ann. Soc. Suisse Chronométrique et du Laboratorie Suisse de Recherches Horlogères* (*Lausanne*), 1946, **2**, 321.—R. W. R.

New Machines for Creep and Creep-Rupture Tests. M. J. Manjoine (*Machinery Lloyd*, 1946, **18**, (25), 96–101).—M. describes machines designed at the Westinghouse Research Laboratories to test high-temp. materials. The lever-arm

creep machine is used for long-term tests and the screw-driven creep-rupture machine for the shorter tests. Both machines are described, together with the two different types of extensometers used. To demonstrate the types of tests made on the two machines, a high-temp. alloy was subjected to a series of tests in which the time to rupture varied over a wide range. Methods of representation of the family of creep-rupture curves and the significance of the " transition point " are discussed.—H. Pl.

The Tensile Test. L. Sanderson (*Machinery Lloyd*, 1946, **18**, (18), 85–88).—S. gives an elementary explanation of limit of proportionality, yield point, max. stress, proof stress, and elongation, and gives details of the B.S.I. standard tensile test-pieces.—H. Pl.

The Testing of Sheet Metal for Pressings. M. C. Boulet (*Usine Nouvelle*, 1947, **3**, (18), 9; (19), 12).—A review of testing machines.—M. E.

Supersonic Inspection of Materials. H. R. Clauser (*Materials and Methods*, 1946, **24**, (2), 379–384).—The principles and applications of reflection and transmission methods of supersonic inspection are outlined.—J. C. C.

For *A.S.T.M. Standards*, see pp. 126–131.

RADIOLOGY

***Radiography and the Fatigue Strength of Spot Welds in Aluminium Alloys.** R. C. McMaster and H. J. Grover (*Weld. J.* (*J. Amer. Weld. Soc.*), 1947, **26**, (3), 223–232).—A series of spot welds, in two-layer combinations of 19 S.W.G. Alclad 24S-T, were prepared under a range of operating conditions. The present report is of a preliminary nature, but indicates that radiography provides a sensitive method of evaluating the properties of spot welds which affect fatigue strength. Fatigue failure occurred in five characteristic ways, which are described. The tensile strength and high-stress fatigue life appeared to be determined primarily by the size of the nugget at the faying plane, whereas the low-stress, long-life fatigue failure was frequently related to the dia. of the corona ring (peripheral zone of bonding between the aluminium surfaces). Increasing the nugget size results in a smaller relative gain in fatigue strength than in tensile strength. It is desirable that welds likely to be subject to fatigue conditions should possess good corona bonding. Inclusions of aluminium cladding in the nugget provide nuclei for the propagation of cracks in high-stress fatigue tests. In the case of simple shear loading, cracks and defects in the nugget have little influence on the fatigue strength since failure occurs at the faying plane or at the extremities of the weld.—P. H.

Importance of Radiography in Inspection. E. L. LaGrelius (*Found. Trade J.*, 1947, **82**, (1606), 139–140).—A general review of current practice in metallurgical radiology.—J. E. G.

Industrial X-Ray Developments. George W. McArd (*Mass Production*, 1947, **23**, (9), 42–46).—An elementary account of some recent applications in metallurgy and elsewhere.—R. W. R.

20-Million-Volt Betatron. —— (*Steel*, 1946, **119**, (22), 68–69, 92).—A description of the betatron and its use in industrial radiography. Material of thickness at least 3 in. can be examined with it.—M. A. V.

For *A.S.T.M. Standards*, see p. 127.

XV.—FOUNDRY PRACTICE AND APPLIANCES

Making a Light Alloy-Snap Flash. J. A. McIntosh (*Found. Trade J.*, 1947, **81**, (1598), 313).

Control of Bronze Melts for the Production of Pressure-Tight Castings. W. A. Baker (*Found. Trade J.*, 1947, **82**, (1610), 229–233; discussion, (1614), 317–318, 324; and *Metal Ind.*, 1947, **71**, (3), 43–46).—Read to the Institute of British Foundrymen. A review of current research on the mechanism involved in the formation of porosity and its effect on the properties of bronze castings. B. discusses the practical application of these researches, with particular reference to the production of sand castings required to be pressure-tight in service.—J. E. G.

***Improvements in Hollow Sticks and Billets by Casting on to Metal Cores [Bronzes and Gun-Metals].** W. T. Pell-Walpole (*Found. Trade J.*, 1947, **81**, (1597), 285–293; **82**, (1602), 44).—It is submitted by P.-W. that the asbestos-wrapped core process should be employed for cored sticks with cores up to 2½ in. dia., and the split-core process for core sticks requiring thicker cores. Cores up to 2½ in. dia. and up to 3 ft. long should be wrapped with asbestos paper (0·015 in. thick), allowing one complete wrapping per 1 in. of core thickness. The core should possess a smooth surface, its dia. being tapered $\frac{1}{16}$ in./ft. length. The asbestos paper should be sealed on to the core with a suspension of 5% aluminium powder in a 2% aqueous solution of a dextrine-type gum; this also serves as a core coat. Before use, the coated core should be baked for not less than 15 min. at 300° C. After the casting has solidified and cooled to approx. 300° C., it should be stripped, water quenched, and allowed to stand for 5 min., after which the core may be readily tapped out. Cores of dia. greater than 2½ in. should be split vertically to form four equal segments. From each radial face a cut should be taken of 0·015 in./in. of core dia. In use, the four segments should be heated to 100° C., dressed with resinous aluminium paint, and set up in the mould with asbestos paper inserts (previously baked at 300° C.) placed between each segment. After the casting has cooled to approx. 300° C., one of the core segments is tapped out, thus releasing the remaining three segments. For either type of core, bronze should be degassed by melting under an oxidizing flux (1 part copper-mill scale, 1 part sea sand, and 1 part either of fused borax or of a lead-free glass). The flux must be removed before casting, and, when scrap or ingot charges have been melted, the necessary additions must be made for oxidation losses (e.g. approx. 0·5% tin, and 0·2–0·3% phosphorus for 2B8 bronze; 0·5% tin and 0·5% zinc for gun-metals; and 0·5% tin and 1% lead for leaded bronzes). The bronze should be top-poured through a pre-heated, moisture-free refractory nozzle. The pouring rate is given by the formula $R = KD$, where R is the rate in lb./min., K is a constant depending on the phosphorus content, and D is the sum of the internal and external dia. of the casting. The value of K should be taken as 6 when the phosphorus content is less than 0·25%, 5 for 0·5–1% phosphorus, and 4 for 1·5–2% phosphorus. The number of streams should be two for castings up to 2 in. dia., four up to 4 in. dia., six up to 8 in. dia., and twelve for larger castings.—J. E. G.

The Use of Base-Metal Alloys in Casting. (Collins). See p. 104.

Sound Copper Castings. L. Sanderson (*Machinery Lloyd*, 1946, **18**, (15), 92–93).—The employment of a modern furnace which has been designed with due attention to melting vol., burner tip dia., choice of lining to provide max. heat radiation in minimum time inside the furnace, correct air pressure and vol., full combustion control, and automatic proportioning, will ensure the production of superior copper melts. Moulding-sand permeability should be about 25, and bottom pouring is recommended.—H. Pl.

Magnesium : Cast Alloys. G. Fitzgerald-Lee (*Machine Shop Mag.*, 1947, **8**, (8), 79–81).—A summary of the properties and applications of magnesium alloys (Magnuminium and Elektron series).—H. V.

Magnesium Moulding Sands. F. A. Allen (*Light Metals*, 1947, **10**, (110), 120–123).—A. introduces the usual sand techniques employed in magnesium foundries and emphasizes their principal disadvantage, which is that the sands are difficult to work; being mainly synthetic, the moulds dry off quickly, and accidental damage is difficult to repair. A. states that equally effective inhibition can be achieved by a special mixture which confers better moulding properties and less tendency to dry out. The novelty in the mixture proposed consists of the addition to the sand of solid boric acid and solid ammonium bifluoride. If these two substances are mixed, an unexpected reaction takes place, and a wet mass is formed. When the sand is milled, the reaction occurs, and moisture is liberated. It is suggested that the chemically evolved water is more effective in wetting the sand than is the water added to it in the ordinary way. Brief test results are given showing that sand containing these inhibitors (as well as the usual sulphur) behaves better from a foundry handling point of view than similar sand containing only the conventional inhibitors.—F. A. F.

[Discussion on R. S. Busk and E. G. Bobalek's Paper :] "Hydrogen in Magnesium Alloys." (——) See p. 101.

[Discussion on R. M. Parke and J. L. Ham's Paper :] "The Melting of Molybdenum in the Vacuum Arc." (——) See p. 97.

Induction Melting Furnaces. (Chesnut). See p. 115.

Some Notes on Feeding. S. L. Finch (*Found. Trade J.*, 1947, **82**, (1613), 297–303; (1614), 319–324; discussion, **83**, (1618), 3–6).—Presented at the Annual Conference of the Institute of British Foundrymen. A detailed account of (1) the mechanism of crystallization, solidification, and shrinkage, (2) the principle of directional solidification, and (3) the factors affecting flow of metal from feeder head to casting.—J. E. G.

[Further Discussion on J. L. Francis's Paper:] "Some Casting Troubles." —— (*Found. Trade J.*, 1946, **80**, (1581), 344).—Cf. *ibid.*, 1946, **79**, 1554, 103–111; see *Met. Abs.*, 1946, **13**, 309.—W. G. A.

Current Problems. Tom Shanks (*Found. Trade J.*, 1946, **80**, (1577), 241–243).—Inaugural Address to the Scottish Branch of the Institute of British Foundrymen.—W. G. A.

The Modern Foundry. —— (*Usine Nouvelle*, 1947, **3**, (12), 12).—A review of English and American methods.—M. E.

Progress in Casting. A Review of American Foundry Practice. —— (*Metallurgia*, 1947, **36**, (212), 97–99).—A digest of papers in *Foundry*, 1946, **74**, (1), 70–103; see *Met. Abs.*, 1946, **13**, 231.—M. A. V.

Vacuum Plate Method for Casting in Porous Moulds and Patterns. Les Wilson (*Materials and Methods*, 1946, **24**, (6), 1505–1506).—A note. In this technique, the plaster mould is placed on a marble plate directly above a hole leading to an aspirator or vacuum pump. A retaining ring is placed around the mould and the space between the ring and the pattern sealed with "Plastiflex". The vacuum system will then abstract air and gases from the mould during the pouring operation.—J. C. C.

Some Notes on the Surface Drying of Moulds. A. Cracknell and F. Cousans (*Found. Trade J.*, 1947, **82**, (1614), 313–315; (1615), 343–347; (1616), 365–369).—Presented at the Annual Conference of the Institute of British Foundrymen. An account of the factors affecting the surface drying of moulds. The authors conclude: (1) that it is unnecessary for the mould temp. to attain 100° C. for the drying of the surface to be accomplished in a reasonable time; in fact, if air is used for drying at a temp. greatly in excess of 300° C. the surface layer of the mould forms an easily broken shell; (2) skin-dried moulds

may be cast satisfactorily with the moisture content of the mould reaching its original value a little over ½ in. from the surface; (3) a high vol. of air at a moderate temp. is necessary to avoid spalling and maintain reasonable drying periods; (4) moulds left to stand after skin drying continue to lose moisture; (5) moulds air dried at shop temp. attain a condition similar to that of skin-dried moulds which have been allowed to stand; (6) the rate of air drying of a mould appears to be an inverse function of the permeability; (7) the employment of a fixed skin temp. in order to attain uniform results is not possible; and (8) skin-dried moulds left to age for short periods can be used satisfactorily.—J. E. G.

Patterns for a Production Foundry. G. A. Pealer (*Found. Trade J.*, 1946, **80**, (1572), 109–110).—Summary of a paper read before the American Foundrymen's Association; see *Met. Abs.*, 1947, **14**, 24.—W. G. A.

Cellulose Derivatives as Core Binders in German Foundries. O. R. J. Lee (*Found. Trade J.*, 1947, **82**, (1606), 135–136).—Details are given of two Alkylin binders, viz. Alkylin 360, a sawdust-like solid described as methyl cellulose, and Alkylin 260, cellulose glycollic acid. The chief characteristics of these binders are: (1) the development of a low hot strength, thus overcoming tearing difficulties in light-alloy castings; (2) low decomposition temp. which results in excellent knock-out characteristics; (3) low gas evolution; and (4) low drying temp. (150° C.).—J. E. G.

Improvements in the Manufacture of Metal Castings by the Centrifugal Method. —— (*Machinery Lloyd*, 1946, **18**, (26), 89–90).—This improved method of manufacturing castings by the centrifugal process is applicable to the rapid casting of any relatively short hollow body. A characteristic feature is that during the casting operation gases are evacuated from the interior of the casting.—H. Pl.

Precision Casting of High-Melting-Point Alloys Containing Nickel. H. Evans, P. S. Cotton, and J. Thexton (*Found. Trade J.*, 1947, **82**, (1609), 205–210; (1610), 223–227; discussion, (1615), 337–342; (1616), 369; **83**, (1621), 64; and (summary) *Aircraft Prodn.*, 1947, **9**, (106), 303–307).—Read to the Institute of British Foundrymen. A detailed and illustrated account of the technique employed for the manufacture of castings in high-m.p. nickel alloys by the lost-wax process. The procedure employed involves the use of zircon flour in the sprayed coating and sillimanite in the investment. —J. E. G.

Principles of Precision Investment Casting. Kenneth Geist and Robert M. Kerr, Jr. (*Found. Trade J.*, 1947, **82**, (1611), 247–254; (1612), 269–273; (1613), 291–296; discussion, (1615), 337–342, (1616), 369; **83**, (1621), 64).—An A.F.A. exchange paper presented at the Annual Conference of the Institute of British Foundrymen. The authors give a detailed and illustrated account of the lost-wax process of investment moulding. Other aspects discussed include plant layout and factors influencing casting design.—J. E. G.

Developments in Investments for the Casting of Gold Alloys and Base Metals. (Moore). See p. 104.

Engineering and Design of Aluminium Permanent Moulds. E. G. Fahlman, E. V. Blackmun, W. J. Brinkman, H. R. Doswell, W. J. Klayer, G. C. Kohls, C. H. Morrison, and E. C. Nocar (*Modern Metals*, 1947, **3**, (7), 24–25).—A concise account of the advantages and disadvantages of the gravity die-casting process, with notes on the design of dies.—N. B. V.

Shrinkage Allowance in Die-Casting Die Design. R. L. Wilcox (*Tool and Die J.*, 1947, **12**, (10), 68–71).—It has been found that published data on solidification shrinkage are usually excessive for die-casting work. The factors affecting the solidification shrinkage of zinc-base alloys, such as rate of cooling, methods of pouring, mould material, &c., are discussed. W. states that one reason why practical shrinkage allowances in die-casting design

work are usually less than those calculated is the fact that the actual average temp. at which a casting is formed in a die is below the freezing point of the alloy. Another important factor tending to reduce the shrinkage-allowance factor from the calculated value is the shape of the casting or its ability to shrink freely in the die. Any restriction on shrinkage in the die, e.g. at the gate opening, gate runner, and overflow wells, will prove the normal shrinkage-allowance factor excessive.—J. S.

Steels for Die-Casting Die Blocks. James L. Erickson (*Materials and Methods*, 1946, **24**, (2), 389–396).—A comprehensive survey.—J. C. C.

For *A.S.T.M. Standards*, see pp. 127–129.

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

Selenium Fume Exposure. Marshall Clinton, Jr. (*J. Indust. Hyg. Toxicol.*, 1947, **29**, (4), 225–226).—A description of cases of selenium poisoning which occurred when some aluminium contaminated with selenium (scrap selenium-rectifier plates) was accidentally charged into a reverberatory furnace melting scrap aluminium. Some of the furnace workers experienced severe symptoms of a temporary nature, rather similar to those produced by sulphur dioxide, but all completely recovered during the course of the next two days. It is concluded that the unpleasant irritating effects limited exposure to the time necessary to escape from the contaminated atmosphere, so that in no instance did significant exposure occur.—R. W. R.

XVII.—FURNACES, FUELS, AND REFRACTORY MATERIALS

Induction Melting Furnaces. Frank T. Chesnut (*Amer. Foundryman*, 1947, **11**, (3), 22–25).—A general review in which are discussed the relative advantages and disadvantages of high-frequency induction furnaces and submerged-resistor furnaces for the melting of non-ferrous metals and alloys.—J. E. G.

Producing High-Purity Metals with Vacuum. J. D. Nisbet (*Iron Age*, 1947, **159**, (25), 56–59).—N. describes a vacuum-melting system in which a centrifugal operation is performed and an arrangement provided for loading and making additions to the furnace without disturbing the vacuum. He outlines the procedure for producing a 6-lb. ingot under less than 50 microns pressure. —J. H. W.

Industrial Fuel in Victoria. J. R. Nicholson (*Proc. Soc. Chem. Ind., Victoria*, 1946, **46**, (1), 739–753; discussion, 753–754).—Among the methods suggested for the more efficient use of coal is the employment of recuperators in industrial furnaces. Tables show the saving in fuel with two different types of recuperators.—J. L. T.

XVIII.—HEAT-TREATMENT

Induction Heating. Edwin Laird Cady (*Materials and Methods*, 1946, **24**, (2), 400–410).—A " materials and methods " manual. Basic types of equipment are described and costs discussed. Uses for hardening and forging ferrous materials are outlined and reference made to induction brazing and soldering.—J. C. C.

Induction Heating. N. R. Stansel (*Iron Steel Eng.*, 1946, **23**, (1), 102–111). —The thermal, electrical, and magnetic properties of metals affecting the induction-heating process are discussed, and formulæ quoted relating the

electrical, physical, and geometrical quantities involved in practice. These formulæ are illustrated graphically. The applications of the process to melting, mass heating, and surface heating are considered.—M. A. V.

Coax Coil for Heating Small Holes. David Baumoel (*Electronics*, 1947, **20**, (9), 160, 162).—An induction-heating work coil is described for the heat-treatment of the inside surfaces of small holes between $\frac{3}{16}$ and $\frac{5}{8}$ in. dia. Co-axial conductors are used. Provision can be made for cooling of the conductors and for quenching of the work-piece in hardening operations.—D. M. L.

How Industry is Using H.F. Heat in Production. —— (*Electronic Ind. and Instrumentation*, 1947, **1**, (7), 5).—A series of photographs is given, showing the use of H.F. heating in production processes where high production rate and close control of heated area are essential. The illustrations show the annealing of chain pins, the silver soldering of a three-piece tube assembly and kitchen utensils, the brazing of radio components, and the edge-glueing of wooden spars.—D. M. L.

Cleaning and Heat-Treating Aluminium Alloy [Castings]. (Rogers, Carl, Seabury, and Smith). See p. 118.

***Effects of Heat-Treating [Silver-]Amalgam Alloy Ingots Before Cutting Into Filings.** (Ray). See p. 105.

[Correspondence on F. W. Jones and W. I. Pumphrey's Paper:] "Some Experiments on Quenching Media." (Miss) R. E. W. Gunn (*J. Iron Steel Inst.*, 1947, **156**, (4), 524).—Cf. *ibid.*, 1947, **156**, 37; see *Met. Abs.*, this vol., p. 61. The calculation of the centre temp. of cylinders, using Schmidt's method in the manner suggested by J. and P., frequently leads to arithmetical fluctuations. G. suggests a way, also based on Schmidt's method, in which these fluctuations may be avoided.—R. W. R.

For *A.S.T.M. Standards*, see pp. 129–131.

XIX.—WORKING

***Research on the Forgeability of Light Alloys.** Paul Bastien (*Publ. Sci. Tech. Ministère Air (France), Rapport* No. **196**, 1946, 76 pp.).—Static and dynamic bending tests give information on the forgeability of a new alloy rapidly and easily. The temp. range over which an alloy can be forged is thus obtained. To investigate the influence of an isolated factor such as crystal size, the most sensitive test is shock bending. The results obtained by B. using such tests are in good agreement with the results obtained in industry. The effect of composition on forgeability is such that when the amount of added metal exceeds the limit of solid solubility at the temp. in question, the extent to which the alloy may be hot worked depends on the constituent precipitated from the solid solution, its nature and form, &c. The study of the plastic deformation of various binary alloys by laboratory procedures, such as those described, which permit quantitative data to be obtained, enables general laws of forgeability applicable to new alloys to be deduced.—J. L. T.

Advantages of Forgings Over Castings. —— (*Non-Ferrous Forgings Digest*, 1947, **2**, (3)).—A brief review.—J. L. T.

Details of a New 18-in. Reversing Cold Steckel Mill. L. W. Law (*Sheet Metal Ind.*, 1947, **24**, (243), 1349–1351, 1365).—R. Gr.

The Application to Shaping Processes of Hencky's Laws of Equilibrium. E. Siebel (*J. Iron Steel Inst.*, 1947, **155**, (4), 526–534; discussion, **156**, (4), 511–522; and *Iron and Steel*, 1947, **20**, (6), 266–268).—The use of Hencky's Laws enables the principal stresses in a body being plastically deformed to be calculated from a knowledge of the slip-line system. Using the rules propounded by Prandtl, S. has deduced the slip-line systems operating in a number of metal-working processes, including direct compression, die-forging, rolling, drawing,

extrusion, and piercing. The effect of friction is considered. In some instances (drawing, extrusion, and piercing) mathematical expressions for the forces acting are derived from consideration of the slip-line diagrams. The method employed assumes conditions of const. shear stress, but S. treats the effect of work-hardening mathematically and shows that the method is valid for a work-hardening material, provided that the slip lines possess the same curvature in both directions; in other instances, the error caused by work-hardening is not large, and the method yields an approx. solution.—R. W. R.

Joint Discussion on "The First Report of the Rolling-Mill Research Sub-Committee" (Special Report No. 34) and on the Papers: "Fluctuations of the Distribution of Torque Between Rolling-Mill Spindles", by E. A. W. Hoff, and "The Application to Shaping Processes of Hencky's Laws of Equilibrium", by E. Siebel. —— (*J. Iron Steel Inst.*, 1947, **156**, (4), 511–522).—Cf. *ibid.*, 1947, **155**, (1), 51; see *Met. Abs.*, this vol., p. 63.—J. L. T.

Modern Extruded Metals. E. J. Cartwright (*Machinery Lloyd*, 1946, **18**, (6), 71–75).—Commercially extrudable metals and alloys range from the soft white metals, lead and tin, through the light alloys of aluminium and magnesium, the copper-base alloys, and the yellow metals, to Monel metal and the nickel-rich alloys. Details of the process and descriptions of some modern extrusion machines are given.—H. PL.

Extruded Shapes Speed Brass Forging Output. Herbert Chase (*Materials and Methods*, 1946, **24**, (1), 103–108).—J. C. C.

[Discussion on J. P. Doan and G. Ansel's Paper:] "Some Effects of Zirconium on Extrusion Properties [and Constitution] of Magnesium-Base Alloys Containing Zinc." (——) See p. 101.

Stamped [Brass and Bronze] Bushings. D. B. Wilkin (*Steel*, 1946, **119**, (22), 64–66, 104).—The stamping of brass and bronze bushings and bearings, steel bushings, and brass ferrules at the works of the National Formetal Company, Cleveland, O., is described.—M. A. V.

Metal Stampings. —— (*Metal Progress*, 1946, **50**, (1), 132, 134, 136, 138).—Advances in production technique and the development of new alloys have extended the applications of stampings; close tolerances permit interchangeability and allow stampings to be built up into complex assemblies or combined with forged or cast pieces. Production, joining, finishing, and application of a protective coating are often undertaken serially in a single factory. Notable advances in practice include (1) improved inspection methods; (2) deep drawing without intermediate annealing; (3) improved welding and brazing methods; (4) introduction of new light alloys; (5) satisfactory enamelled coatings for steels, in some cases successfully used on copper-brazed joints; and (6) production of larger and heavier hot pressings, both in steel and in aluminium and brass. Further development in the press forming of magnesium sheet is regarded as desirable.—P. R.

***The Turning of Light Alloys.** René Schweyckart (*Rev. Aluminium*, 1947, **(130)**, 44–51).—A study of the forces acting on tools and of the formation of chips in the turning of light alloys. Stresses are lowest when the ratio of longitudinal feed in mm. per revolution to transverse feed in mm. is greater than 0·4 for pure aluminium and greater than 0·5 for aluminium alloys.—M. E.

The Machining of Magnesium. —— (*Usine Nouvelle*, 1947, **3**, (9), 13).—M. E.

Wet-Belt Machining Method [for Castings]. William F. Schleicher (*Aluminum and Magnesium*, 1947, **3**, (5), 8–10, 20, 22).—S. deals with a new process for grinding metal parts, usually castings, by means of a cooled abrasive belt. The novelty lies in the recent successful development of a suitable belt which will withstand the effects of the coolant, and of special-purpose grinding machines for using them. Flat or curved faces can be surfaced at speeds of the order of 4000 ft./min. for aluminium alloy. The grit

may be silicon carbide and is plastic-bonded to a cloth backing; it is applied by an electrostatic method. Tolerances as close as 0·0005 in. have been maintained. The coolant used is soluble oil in water. Particulars of various successful applications are given.—F. A. F.

XX.—CLEANING AND FINISHING

Cleaning and Heat-Treating Aluminium Alloy [Castings]. W. J. Rogers, F. Carl, R. Seabury, and N. Smith (*Modern Metals*, 1947, **3**, (6), 24–26).—A review of current practice.—N. B. V.

Surface Finishes for Aluminium [and Its Alloys]. J. F. Mason (*Machines et Métaux*, 1947, **31**, (349), 311).—Translated from *Iron Age*, 1946, **158**, (9), 40–43; (10), 50–53; (11), 66–69; see *Met. Abs.*, 1946, **13**, 439.—J. L. T.

Electropolishing. Charles L. Faust (*Machinery Lloyd*, 1946, **18**, (12A), 37–43).—F. discusses some of the industrial applications and limitations of electrolytic polishing. Its applicability to the polishing of recessed surface areas is cited as the outstanding advantage of the process. For practical purposes, ferrous alloys are generally polished in the same solutions, whereas special combinations are used for the non-ferrous metals. Electropolishing uniformly removes the excess metal from the outside dia. of screws so that it can be replaced by electrodeposited metal and still maintain the dimensional tolerances originally specified.—H. Pl.

Vapour Blast: Some Recent Developments. D. Grant (*Machinery Lloyd*, 1946, **18**, (22), 67–72; (25A), 37–41).—Difficulties in maintaining an "electro-clean" surface during the scouring of a 40 ft. × 60 ft. steel sieve prior to copper plating were overcome by using a technique known as "copper multi-coating". In this process, both the cleaning of the steel and the work-hardening of the deposit were carried out with a low-velocity heavy-sand abrasive stream, the plating proceeding at the same time.—H. Pl.

XXI.—JOINING

Soldered *versus* Double-Seamed Closures. C. H. Hannon (*Metal Progress*, 1946, **49**, (6), 1171–1172).—Capacitor casings of standard type can be sealed without soldering by using a double-seamed closure, mechanically spinning the cover on to the body, and applying a metallic sealing adhesive before the final heat-treatment. The adhesive must be unaffected by the thermal treatment and must not contaminate the dielectric material.—P. R.

***Contribution to the Study of the Phenomena of Expansion and Shrinkage [in Soldering].** P. Berthet (*Soudure et Techniques Connexes*, 1947, **1**, (1/2), 25–33; and (abridged) *Weld J.* (*J. Amer. Weld. Soc.*), 1947, **26**, (7), 370–371s).—B. describes a method of measuring the shrinkage of solder on sheets by means of bend tests. Increasing the speed of the process decreases the shrinkage of the solder.—M. E.

Brazing Lawn-Mower Rotors. —— (*Electronics*, 1947, **20**, (9), 168, 170).—An illustrated description of the brazing of three parts—spider, driver-shaft, and bearing retainer—in one operation. Four assemblies are brazed at one time, the complete heating cycle being 30 sec. The method of assembly and the system of jigs for holding the assemblies in the heating coils are described. The brazing medium is silver solder.—D. M. L.

Automatic Induction Brazing Speeds Tool Tipping. —— (*Iron Age*, 1946, **157**, (15), 54–55).—The author describes the induction brazing of tungsten carbide tips on to cutting tools. The use of induction heating results in a considerable saving of time.—R. W. R.

Eutectic Low-Temperature Welding. R. D. Boyle (*Australasian Eng.*, **1946,** (Aug.), 71–73).—B. describes the eutectic low-temp. welding process, which, though similar to brazing, differs from it in that the temp. used is below the m.p. of the filler metal. The latter is specially chosen to form easily a eutectic with the parent metal. Suitable alloys have been developed for use with cast iron, steel, copper alloys, and aluminium alloys.—N. B. V.

***Static and Fatigue Tests of Arc-Welded Aluminium Alloy 61S-T Plate.** E. C. Hartmann, Marshall Holt, and A. N. Zamboky (*Weld. J.* (*J. Amer. Weld. Soc.*), 1947, **26,** (3), 129–138s).—The tests were conducted on 15 types of panels fabricated by arc welding from ⅜-in.-thick aluminium alloy of nominal composition: copper 0·25, magnesium 1·0, silicon 0·6, chromium 0·25%, balance aluminium. Panels with dressed butt welds gave the highest fatigue strengths observed in these tests, with values of 49–54% of the solid specimen. Fatigue failure in this type of joint was associated, in very many cases, with spatter marks on the parent plate. Static tensile tests showed a max. joint efficiency of approx. 50% in the case of butt welds without dressing. As with most of the other types of panels, butt joints gave tensile values in excess of the tensile strength of the annealed material. The least satisfactory joints in either tensile or fatigue tests were those of asymmetrical design. No improvement in tensile strength, or fatigue strength at long life, was observed as a result of scalloping the edges of the plates. Inferior results were obtained from panels with splice plates fastened by fillet welds across the main joint.—P. H.

Fabricating Sheet-Metal Parts of Jet Engines. Harold A. Knight (*Materials and Methods*, 1946, **24,** (6), 1461–1465).—Brief notes are given on the welding of Inconel combustion-chamber liners.—J. C. C.

Fine Silver Welded Tubing. J. G. Henderson (*Product Eng.*, 1947, **18,** (6), 160).—Practical hints on the welding of silver and the handling of silver tubing. The density, tensile strength, elongation, hardness, m.p., thermal conductivity, malleability, ductility, and work-hardenability of 99·9% commercial silver are tabulated.—J. L. T.

Ensuring the Best Results from Welding. R. King (*Mass Production*, 1947, **23,** (10), 65, 74).—An elementary account of some points of technique.

—R. W. R.

Modern Resistance Welding: Costs, Design, and Application. W. Bernard (*Australasian Eng.*, **1946,** (Sep.), 58–63).—A paper read before the Australian Welding Institute, Sydney Branch. Spot, projection, and seam welding are reviewed.—N. B. V.

Some Fundamental Principles for the Resistance Welding of Sheet Metal. H. E. Dixon (*Sheet Metal Ind.*, 1947, **24,** (243), 1430–1435).—The factors which influence the spot welding of aluminium-base alloys are considered under the following heads: contact resistance, welding heavy gauges, effect of material composition, and general features in spot welds (coated Duralumin-type alloys). Flash and butt welding of light alloys are also considered.—R. Gr.

Design of Fixtures for Projection Welding. Mario L. Ochieano (*Iron Age*, 1946, **157,** (18), 55–56).—Some simple rules are given.—R. W. R.

Technique for the Gas Welding of Magnesium Alloys. (*Brit. Weld. Research Assoc. Pub.*, 1946, **T.16,** 38 pp.).—This useful brochure was prepared by a special panel of a Committee of the British Welding Research Association, and covers the whole field of gas welding of magnesium alloys, except that the repair of castings is not dealt with in detail. The booklet is comprehensive and deals with the effect of composition of the alloy, the welding flame, fluxes, design, and manipulation. Finishing and protective treatments are described at some length, and weld defects and inspection are also considered. There are more than twenty illustrations, including photomicrographs.

—F. A. F.

***The Chemical Surface Treatment of Magnesium Alloy Sheet for Spot Welding.** W. F. Hess, T. B. Cameron, and D. J. Ashcraft (*Weld. J.* (*J. Amer. Weld. Soc.*), 1947, **26**, (3), 170–190s).—The suitability of various reagents for preparing magnesium alloys for spot welding has been investigated. A solution of universal application, containing 10% chromic acid and 0·05% sodium sulphate is given particular attention. This solution has a relatively short active life and requires regeneration by addition of sodium sulphate. Analytical control is necessary, and suitable methods are discussed. Material from one supplier responded satisfactorily to a solution of chromic acid without additions, and this was attributed to a trace of sulphate acquired by the surface of the sheet when in the mill. Plain chromic acid solutions differ from other reagents in producing a discontinuous attack, which gives a longer active life to the bath. Results are improved and chromic acid saved if this treatment follows a hot alkaline cleaner. Solutions of chromic and nitric acids are not readily adaptable to different alloys and tempers, and are critical in use. The first step in surface preparation was degreasing in trichlorethylene. A 20% solution of acetic acid was effective in removing chromate pickle finish, leaving a surface suitable for preparation by other reagents. Where spot welding is envisaged, it is an advantage to use stock which has not received a chromate pickle finish. Chemical preparation is convenient for spot welding and is in no way inferior to scratch brushing, following which treatment the surface resistance will rapidly increase in hot and humid atmospheres. The use of chemically prepared stock gives a longer electrode tip life.—P. H.

High-Speed Spot Welding. Bernard Gross (*Iron Age*, 1946, **157**, (8), 52–55).—G. discusses the advantages of spot welding and describes the welding machines and techniques used. Various means of speeding-up the process are considered.—R. W. R.

Inspection and the Resistance Spot Welding of Light Alloys. Michael Smith (*Australasian Eng.*, **1946**, (Mar.), 45–48).—An account of the spot-welding process and of the duties of Government inspectors.—N. B. V.

Spot Welding of Assemblies. Floyd Matthews (*Aero Digest*, 1947, **54**, (4), 82).—Spot-welding procedure for the fastening of internal corrugated stiffener panels to the centre wing skin sections at the Boeing Aircraft factory is summarized. A preliminary determination of the electrical resistance between surface films is carried out, and adjustments are made to the cleaning procedure until this resistance is less than 21 microhms.—H. Pl.

***Radiography and the Fatigue Strength of Spot Welds in Aluminium Alloys.** (McMaster and Grover). See p. 111.

Welding. H. E. Linsley (*Iron Age*, 1946, **157**, (1), 136–138, 141, 278, 280, 282).—A review of the position of welding at the beginning of 1946. Some recent developments, such as the spot welding of heavy-gauge aluminium sheet and the Heliarc welding of stainless-steel sheet, are described.
—R. W. R.

The Principles of Welding Metallurgy. J. Candlish (*Australasian Eng.*, **1946**, (May), 36–46).—A paper read before the Sydney Branch of the Australian Welding Institute.—N. B. V.

Machining of Arc-Welded Products. Walter J. Brooking (*Iron Age*, 1943, **152**, (24), 54).—B. stresses the advantages which frequently accrue from the pre-machining of parts and sub-structures, and describes the precautions which must be taken when welding these to the main assembly.—R. W. R.

Symposium "Welding and Health". (1) **Welding and Fire.** D. V. Mills (*Australasian Eng.*, **1946**, (Aug.), 73–74); (2) **Welding and Electric Shocks.** H. S. Lloyd (*ibid.*, (Sep.), 48–49); (3) **Welding and Eyes.** R. G. Giovanelli

(*ibid.*, (Oct.), 89–90); **(4) Welding and Fumes.** Gordon C. Smith (*ibid.*, (Nov.), 79–81).—Papers read at a symposium held by the Australian Welding Institute. Health hazards in welding are dealt with and precautions described.
—N. B. V.

Rotor-Blade Production [Use of Cycleweld Cements]. John T. Parsons (*Aero Digest*, 1947, **54**, (3), 73, 132–134).—Cycleweld cements develop thoroughly satisfactory values on a collar-to-spar application when the procedure is rigidly controlled and the fixtures are properly designed. P. describes methods of overcoming difficulties due to the expansion of the Sikorsky R-5 spar and the tendency of joints to slide out of alignment just before the curing temp. of these cements.—H. PL.

For *A.S.T.M. Standards*, see p. 128.

XXII.—INDUSTRIAL USES AND APPLICATIONS

Air-Conditioning System for the Martin 3–0–3 [Aeroplane]. P. H. Portteus (*Modern Metals*, 1947, **3**, (7), 14–15).—A description of the part played by light-alloy components in aircraft pressurizing and air-conditioning equipment.—N. B. V.

The Tucker [Automobile] Gets Under Way. W. B. Griffin (*Modern Metals*, 1947, **3**, (7), 12–13).—A brief description of the "Tucker '48", which is planned to incorporate a much greater quantity of light metals than any previous car.—N. B. V.

New [Aluminium] Chemical Drum. —— (*Modern Metals*, 1947, **3**, (7), 19).—Designed primarily for transporting hydrogen peroxide, the 30-gal. drum described may also be used for a wide range of other chemicals. The drum is made by Heliarc-welding together of two deep-drawn halves of high-purity (99·6% and over) aluminium, and is reinforced with high-strength alloy extrusions. It weighs 34 lb., or about half the weight of a comparable steel drum.—N. B. V.

Aluminium and Its Alloys in Present-Day Construction. G. W. McArd (*Mech. World*, 1947, **122**, (3166), 279–281).—A brief review of the applications and advantages of aluminium alloys in building construction and automotive engineering.—R. W. R.

Aluminium Jeep Tops. J. A. Carson (*Modern Metals*, 1947, **3**, (6), 16).
—N. B. V.

Designing a Combination Lighter and Cigarette Case [in Aluminium Alloy Die-Castings]. Fred F. Fukal (*Modern Metals*, 1947, **3**, (6), 20–21).—N. B. V.

Paint-Spraying Equipment Utilizes Aluminium Forgings. —— (*Modern Metals*, 1947, **3**, (7), 30).—The one-piece body of the spray gun described here is of a high-strength aluminium alloy forged and heat-treated to give max. strength. The total weight of the gun is 26 oz.—N. B. V.

Pressed [Aluminium Alloy] Pistons for Heavy-Duty Diesel Engines. L. P. Gibson (*Machinery Lloyd*, 1946, **18**, (25A), 46–50).—Experience gained with pressed pistons in the aircraft industry has been applied to heavy-duty oil engines. "Y" alloy is considered as the strongest known piston alloy, while an aluminium–12% silicon alloy, "Lo-Ex", has a slightly lower coeff. of expansion and possesses relatively high hot-strength values. G. summarizes the fundamental differences between cast and pressed pistons and outlines the press-shop technique.—H. PL.

Precision [Aluminium Alloy] Trailer Coaches. —— (*Modern Metals*, 1947, **3**, (6), 27).—For the all-metal caravan trailer described, 3S sheet is used for walls and roof in conjunction with 24S-T Alclad extrusions.—N. B. V.

Aluminium Water Pump [for Cooling Automobile Engines]. —— (*Modern Metals*, 1947, **3**, (6), 15).—The pump described weighs 40% less than a cast-

iron one, reduces corrosion troubles in the cooling system, and leads to higher engine efficiency.—N. B. V.

Light Metals and Tenite Plastic for Piano Actions. —— (*Modern Metals*, 1947, **3**, (7), 27).—Magnesium alloy extrusions are used for the main rail and hammer rail.—N. B. V.

Magnesium in Electrical Batteries. Harold A. Knight (*Materials and Methods*, 1946, **24**, (6), 1469–1472).—The construction and characteristics of magnesium–silver-chloride batteries with sea water as electrolyte are briefly discussed; dimensions and discharge data of some commercial cells are tabulated.—J. C. C.

Engraved Magnesium Plates Cut Printing Costs. —— (*Modern Metals*, 1947, **3**, (7), 28–29).—Reprinted from *Editor and Publisher*, 19 July 1947. The possibility of reducing newspaper production costs by as much as 50% is opened up by the process described, which consists of photo-engraving matter typed by electromatic proportional-spacing machines. All typesetting and stereo-casting is thereby eliminated. Magnesium is used for the plates because it is light and easy to etch. The plates can be used on either flat-bed or rotary presses.—N. B. V.

Selling Magnesium in Canada. A. C. Norcross (*Modern Metals*, 1947, **3**, (6), 12–14).—A survey of the wide range of products of a Canadian magnesium foundry.—N. B. V.

Manufacturing a Magnesium Combination Storm and Screen Window. —— (*Modern Metals*, 1947, **3**, (7), 20–21).—N. B. V.

Mechanical Filtration with Metal Filter Cloths. R. F. Black (*Nickel Bull.*, 1947, **20**, (1/2), 33–34).—Abstracted from *Internat. Sugar J.*, 1946, **48**, 207–208.—J. S.

[Production of] Ultra-Thin Nickel Ribbons [for Use in Bolometers]. (Brockman). See p. 109.

[Zinc] Die-Casting to Relieve Labour Shortage. —— (*Mech. World*, 1947, **122**, (3165), 259–260).—A description of the merits of zinc-base die-castings, as opposed to cast-iron sand castings, for electrical switch-gear.—R. W. R.

Zinc Alloy [Die-]Castings. New Applications. — Grunberg (*Usine Nouvelle*, 1947, **3**, (17), 11).—A brief report of a paper presented at le Centre d'Études Supérieures de Métallurgie. The chief cause of failure of die-castings is intercrystalline corrosion. Three alloys have been standardized in America: Zamak 2, 3, and 5. They have many uses in small decorative parts, especially when chromium plated.—J. L. T.

Zinc Alloy Moulds for Short Runs. —— (*Modern Plastics*, 1946, **23**, (12), 150).—To produce small quantities of clear plastic models at low cost and with equipment available in the U.S. Army model shops, a new process using zinc alloy moulds has been evolved.—H. Pl.

The Production of Die-Castings for Ford Carburetters. Herbert Chase (*Machinery* (*Lond.*), 1947, **71**, (1818), 242–246).—J. C. C.

Development in Aircraft-Engine Metallurgy, 1920–1946. Walter E. Jominy (*Metal Progress*, 1946, **50**, (4), 687–690).—Outstanding metallurgical advances in aircraft-engine production from 1920 onwards include: (1) the use of sintered carbides; (2) induction heating; (3) chromium plating; (4) the availability of new materials: accounts are given of the applications of magnesium castings, silver (especially in bearings), aluminium alloy forgings, and Nitralloy; and (5) the control of grain-size in steel.—P. R.

Naval Engineering Duty in War-Time. Richard Doughton, Jr. (*Metal Progress*, 1946, **50**, (3), 455–461).—The metallurgical aspects of naval engineering are reviewed. Under war conditions, difficulty was caused by the use of such substitute materials as lead for tin in bearing metals and the softer grades of Monel metal for K-Monel in pump impeller rings, casing rings, and impeller nuts. Const. maintenance of a high standard of efficiency was

demanded, as was a wide variety of repairs at sea, often of major importance. Large vessels possessed a machine shop, blacksmith's and coppersmith's shops, and welding and flame-cutting equipment, together with melting and annealing equipment built up by the engineering personnel. Stock materials included mild-steel bar and rod, brass, copper, and Monel metal bar and sheet, and several types of electrode, zinc bars, and plate. Accounts are given of the casting of zinc pencils from spelter when rod was no longer available and of the use of 25 : 20 chromium–nickel electrodes.—P. R.

Centrifugal Castings in the Shipbuilding Industry. N. Sokolov (*Fonderie*, 1947, **1**, (14), 546–548).—A condensed translation from *Sudostroenie*, **1945**, (3/4), 25–31 ; see *Met. Abs.*, 1946, **13**, 373).—J. L. T.

Hard Alloys Go Underground. Sheldon P. Wimpfden (*Min. and Met.*, 1947, **28**, (483), 148–149).—Describes the application of tungsten carbide insert-bits in rock drills.—N. B. V.

Mechanized Wiring. John Markus (*Sci. American*, **1946**, (Aug.), 63–65). —Many hand operations in wiring various electrical and electronic mechanisms can be eliminated by the use of sprayed-metal coatings, preformed and welded harnesses, and metallic paints applied through silk screens.—H. Pl.

Metal Coatings on Ceramics. E. Rosenthal (*Electronic Eng.*, 1946, **18**, (222), 241–242, 262).—The Schoop spraying process is being applied with satisfactory results to high-voltage power bushings. The adherence is improved if the coating is applied to a glaze having a lower softening temp. than the porcelain body. Not all metals adhere equally well ; in the case of copper it is advisable that ground layers of other metals should first be applied. The application of the coating by cathode volatilization or by reduction of metals from salt solutions has the disadvantage, in common with the Schoop process, that dimensional control of the deposited layer is extremely difficult. The burning of metal preparations containing ceramic fluxes on to the ceramic has solved the problem of adherence, and details of this process are given. A ceramic rod can be covered with a thin, burnt-on silver coating, the thermal expansion of which is solely determined by the thermal expansion of the ceramic. Use is made of this fact in the manufacture of metallized ceramic coils which exhibit inductance changes which vary little with varying temp.—H. Pl.

Metal-Coated Plastics. —— (*Modern Plastics*, 1946, **24**, (4), 106–108).—There are three ways of applying films of metal to plastic surfaces : (1) *in vacuo* and at high temp., when the metal disintegrates and falls like dew on the plastic model, (2) a shiny metallic spray can be applied to plastics by air pressure, and (3) a coating of silver can be painted or screen-printed on a plastic surface ; this silver deposit acts as an electrical conductor for the application of an electroplated coat. A recent application of metal spraying is a radio chassis, in which the metal connections are sprayed on to a plastic housing in one operation. The sprayed metal forms strips 0·1 in. wide and 0·0002 in. thick, eliminating the need for a soldering iron in radio assembly. —H. Pl.

[Metals in] Plastics Engineering in 1946. —— (*Modern Plastics*, 1947, **24**, (5), 137–146).—Many new aircraft will have flooring made with honeycomb faced with an aluminium alloy skin. In one installation, a 35% saving in weight, with a 30% increase in strength, was effected. Vacuum evaporation is used to apply metallic coatings to plastics. Coatings of aluminium and silver on sheet methyl methacrylate give very good mirror surfaces. The advantages of beryllium copper as a mould material for plastics are given.—H. Pl.

Metal Thread Sealed Between Acetate Film. —— (*Modern Plastics*, 1946, **24**, (3), 121).—A metallic yarn which will not tarnish with age or exposure to light is the latest fashion discovery. The aluminium, gold, silver, or copper yarns are sealed between two plies of specially formulated cellulose acetate

film. The metallic yarns are supplied mainly in flat form, $\frac{1}{64}$ or $\frac{1}{32}$ in. wide. In each width there are two grades, one yielding (for aluminium) 4600 yd./lb. in the $\frac{1}{32}$-in. width and 8600 yd./lb. in the $\frac{1}{64}$-in. width, and the other grade yielding, for these widths, 6000 and 11,000 yd./lb., respectively.—H. Pl.

Coming Changes in Metal Economics. Fred P. Peters (*Sci. American*, **1946**, (Dec.), 258–260).—Light metals are likely to be in a better competitive cost position in 1955. Copper, zinc, and lead are likely to be more expensive in a few years. The power required to machine several common metals is in the proportion: magnesium 1·0, aluminium alloys 1·8, yellow brass 2·3, cast iron 3·5, mild steel 6·3, and nickel alloys 10·0. Shortage of tin in America has led to the substitution of aluminium and aluminium-coated steel for tin-plate; aluminium, beryllium, silicon, and manganese bronzes are making inroads on the tin-bronze markets.—H. Pl.

Heavy Alloy. (Price). See p. 105.

Rubber–Metal Composites. James A. Merrill (*Materials and Methods*, 1946, **24**, (4), 891–895; and (summary) *Machines et Métaux*, 1947, **31**, (341), 8).—Characteristics of natural and synthetic rubbers which can be bonded to metals are outlined, and some typical applications of bonded composites are described.—J. C. C.

SPECIFICATIONS FOR COPPER AND COPPER ALLOYS

Copper Sheet and Strip: Annealed. —— (*Aeronaut. Material Specification* (*S.A.E.*), 1946, (**AMS 4500B**), 2 pp.).—A revised specification.—J. L. T.

Brass Sheet and Strip: Half Hard. —— (*Aeronaut. Material Specification* (*S.A.E.*), 1946, (**AMS 4507A**), 2 pp.).—A revised specification.—J. L. T.

Phosphor-Bronze Strip. Spring Temper. —— (*Aeronaut. Material Specification* (*S.A.E.*), 1946, (**AMS 4510B**), 2 pp.).—A revised specification.—J. L. T.

Bronze Strips. —— (*Aeronaut. Material Specification* (*S.A.E.*), 1946, (**AMS 4520C**), 2 pp.).—A revised specification.—J. L. T.

Brass Rods and Bars. Free Cutting: Half Hard. —— (*Aeronaut. Material Specification* (*S.A.E.*), 1946, (**AMS 4610C**), 3 pp.).—A revised specification.—J. L. T.

Naval Brass. Rods and Bars: Half Hard. —— (*Aeronaut. Material Specification* (*S.A.E.*), 1946, (**AMS 4611A**), 2 pp.).—A revised specification.—J. L. T.

Brass Forgings. —— (*Aeronaut. Material Specification* (*S.A.E.*), 1946, (**AMS 4614C**), 2 pp.).—A revised specification.—J. L. T.

Silicon-Bronze Bars. Hard. —— (*Aeronaut. Material Specification* (*S.A.E.*), 1946, (**AMS 4615A**), 2 pp.).—A revised specification.—J. L. T.

Manganese-Bronze Forgings. —— (*Aeronaut. Material Specification* (*S.A.E.*), 1946, (**AMS 4619A**), 2 pp.).—A revised specification.—J. L. T.

Phosphor-Bronze Bars. Hard. —— (*Aeronaut. Material Specification* (*S.A.E.*), 1946, (**AMS 4625C**), 2 pp.).—A revised specification.—J. L. T.

Aluminium-Bronze Bars. —— (*Aeronaut. Material Specification* (*S.A.E.*), 1946, (**AMS 4630B**), 2 pp.).—A revised specification.—J. L. T.

Aluminium-Bronze Bars. Silicon. —— (*Aeronaut. Material Specification* (*S.A.E.*), 1946, (**AMS 4631A**), 2 pp.).—A revised specification.—J. L. T.

Aluminium-Bronze Bars. Hard. —— (*Aeronaut. Material Specification* (*S.A.E.*), 1946, (**AMS 4632A**), 2 pp.).—A revised specification.—J. L. T.

Beryllium-Copper Alloy Bars and Forgings. Solution-Treated. —— (*Aeronaut. Material Specification* (*S.A.E.*), 1946, (**AMS 4650B**), 2 pp.).—A revised specification.—J. L. T.

Standard [A.S.T.M.] Specifications for Lake Copper Wire Bars, Cakes, Slabs, Billets, Ingots, and Ingot Bars (B4–42). —— (*Book of A.S.T.M. Standards*, **1946**, (Pt. 1B), 1–4); **Standard [A.S.T.M.] Specifications for Electrolytic Copper**

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Specifications for Copper Bus-Pipes and Tubes (B188–46T). —— (*ibid.*, 492–497); Standard [A.S.T.M.] Method of Test for Expansion (Pin Test) of Copper and Copper Alloy Tubing (B153–45). —— (*ibid.*, 165–166); Tentative [A.S.T.M.] Specifications for Copper-Base Alloys in Ingot Form for Sand Castings (B30–45T). —— (*ibid.*, 498–502); Standard [A.S.T.M.] Classification of Cast Copper-Base Alloys (B119–45). —— (*ibid.*, 167–170); Standard [A.S.T.M.] Specifications for Steam or Valve Bronze Castings (B61–46). —— (*ibid.*, 171–173); Standard [A.S.T.M.] Specifications for Composition-Brass or Ounce Metal Castings (B62–46). —— (*ibid.*, 174–176); Standard [A.S.T.M.] Specifications for Bronze Castings in the Rough for Locomotive Wearing Parts (B66–46). —— (*ibid.*, 177–179); Standard [A.S.T.M.] Specifications for Car and Tender Journal Bearings, Lined (B67–46). —— (*ibid.*, 180–182); Tentative [A.S.T.M.] Specifications for Bronze Castings for Turntables and Movable Bridges and for Bearing and Expansion Plates of Fixed Bridges (B22–46T). —— (*ibid.*, 503–505); Tentative [A.S.T.M.] Specifications for Leaded High-Strength Yellow Brass (Manganese Bronze) Sand Castings (B132–46T). —— (*ibid.*, 506–508); Tentative [A.S.T.M.] Specifications for Tin-Bronze and Leaded Tin-Bronze Sand Castings (B143–46T). —— (*ibid.*, 509–512); Tentative [A.S.T.M.] Specifications for High-Leaded Tin-Bronze Sand Castings (B144–46T). —— (*ibid.*, 513–516); Tentative [A.S.T.M.] Specifications for Leaded Red-Brass and Leaded Semi-Red-Brass Sand Castings (B145–46T). —— (*ibid.*, 517–520); Tentative [A.S.T.M.] Specifications for Leaded Yellow-Brass Sand Castings for General Purposes (B146–46T). —— (*ibid.*, 521–524); Tentative [A.S.T.M.] Specifications for High-Strength Yellow-Brass (Manganese Bronze) and Leaded High-Strength Yellow-Brass (Leaded Manganese Bronze) Sand Castings (B147–46T). —— (*ibid.*, 525–528); Tentative [A.S.T.M.] Specifications for Aluminium-Bronze Sand Castings (B148–46T). —— (*ibid.*, 529–532); Tentative [A.S.T.M.] Specifications for Leaded Nickel-Brass (Leaded Nickel-Silver) and Leaded Nickel-Bronze (Leaded Nickel Silver) Sand Castings (B149–46T). —— (*ibid.*, 533–536); Tentative [A.S.T.M.] Specifications for Silicon-Bronze and Silicon-Brass Sand Castings (B198–46T). —— (*ibid.*, 537–540); Tentative [A.S.T.M.] Recommended Practice for Preparing Tension-Test Specimens for Copper-Base Alloy Castings (B208–46T). —— (*ibid.*, 541–543); Tentative [A.S.T.M.] Specifications for Copper-Base (Brass) Alloy Die-Castings (B176–42T). —— (*ibid.*, 671–672); Tentative [A.S.T.M.] Methods of Radiographic Testing of Metal Castings (E15–39T). —— (*ibid.*, 860–864); Tentative [A.S.T.M.] Industrial Radiographic Terminology for Use in Radiographic Inspection of Castings and Weldments (E52–45T). —— (*ibid.*, 872); Standard [A.S.T.M.] Specifications for Brazing Solder (B64–43). —— (*ibid.*, 206–207).

ALUMINIUM AND ITS ALLOYS

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for Use in Welded Pressure Vessels (B126–46T). —— (*ibid.*, 579–582); Tentative [A.S.T.M.] Specifications for Aluminium Alloy Drawn Seamless Tubing (B210–46T). —— (*ibid.*, 583–586); Tentative [A.S.T.M.] Specifications for Aluminium and Aluminium Alloy Metal Arc-Welding Electrodes (B184–43T). —— (*ibid.*, 587–590); Standard [A.S.T.M.] Specifications for Aluminium Ingots for Remelting (B24–46). —— (*ibid.*, 183–184); Standard [A.S.T.M.] Method of Test for Dielectric Strength of Anodically Coated Aluminium (B110–45). —— (*ibid.*, 185–186); Standard [A.S.T.M.] Method of Test for Sealing of Anodically Coated Aluminium (B136–45). —— (*ibid.*, 187); Standard [A.S.T.M.] Method of Test for Weight of Coating on Anodically Coated Aluminium (B137–45). —— (*ibid.*, 188–189); Tentative [A.S.T.M.] Specifications for Aluminium-Base Alloy Die-Castings (B85–46T). —— (*ibid.*, 669–670).

MAGNESIUM AND ITS ALLOYS

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ZINC, LEAD, AND TIN

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SILVER SOLDERS

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NICKEL AND ITS ALLOYS

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and Bars (B160–41T). —— (*ibid.*, 622–626); Tentative [A.S.T.M.] Specifications for Nickel–Copper Alloy Rods and Bars (B164–41T). —— (*ibid.*, 627–631); Tentative [A.S.T.M.] Specifications for Nickel–Chromium–Iron Alloy Rods and Bars (B166–41T). —— (*ibid.*, 632–636); Tentative [A.S.T.M.] Specifications for Nickel Cold-Drawn Pipe and Tubing (B161–41T). —— (*ibid.*, 637–640); Tentative [A.S.T.M.] Specifications for Nickel–Copper Alloy Cold-Drawn Pipe and Tubing (B165–41T). —— (*ibid.*, 641–644); Tentative [A.S.T.M.] Specifications for Nickel–Chromium–Iron Alloy Cold-Drawn Pipe and Tubing (B167–41T). —— (*ibid.*, 645–648); Tentative [A.S.T.M.] Specifications for Nickel, Nickel–Copper Alloy, and Nickel–Chromium–Iron Alloy Seamless Condenser Tubes and Ferrule Stock (B163–41T). —— (*ibid.*, 649–652); Tentative [A.S.T.M.] Specifications for Nickel Plate, Sheet, and Strip (B162–41T). —— (*ibid.*, 653–657); Tentative [A.S.T.M.] Specifications for Nickel–Copper Alloy Plate, Sheet, and Strip (B127–41T). —— (*ibid.*, 658–663); Tentative [A.S.T.M.] Specifications for Nickel–Chromium–Iron Alloy Plate, Sheet, and Strip (B168–41T). —— (*ibid.*, 664–668); Tentative [A.S.T.M.] Specifications for Round Nickel Wire for Lamps and Electronic Devices (B175–45T). —— (*ibid.*, 688–690); Tentative [A.S.T.M.] Methods of Testing Nickel and Nickel Alloy Wire and Ribbon for Electronic-Tube Filaments (B118–42T). —— (*ibid.*, 691–693).

METHODS OF TESTING

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Diameter by Weighing of Fine Wires Used in Electronic Devices and Lamps (B205–45T). —— (*ibid.*, 708–710); Tentative [A.S.T.M.] Method of Life Test of Electrical-Contact Materials (B182–46T). —— (*ibid.*, 711–718); Tentative [A.S.T.M.] Method of Test for Equivalent Yield Stress of Thermostat Metals (B191–44T). —— (*ibid.*, 719–722).

POWDER METALLURGY

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ELECTRODEPOSITION

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PRACTICES AND DEFINITIONS

Tentative [A.S.T.M.] Methods of Preparation of Metallographic Specimens (E3–46T). —— (*Book of A.S.T.M. Standards*, 1946, (Pt. 1B), 814–859); Tentative [A.S.T.M.] Recommended Practice for Identification of Crystalline Materials by the Hanawalt X-Ray Diffraction Method (E43–46T). —— (*ibid.*, 865–871); Tentative [A.S.T.M.] Methods of Compression Testing of Metallic Materials (E9–46T). —— (*ibid.*, 873–876); Tentative [A.S.T.M.] Methods of Impact Testing of Metallic Materials (E23–41T). —— (*ibid.*, 877–890); Tentative [A.S.T.M.] Recommended Practices for Designation of Numerical Requirements in Standards (E29–40T). —— (*ibid.*, 891–898); Standard [A.S.T.M.] Definitions of Terms Relating to Metallography (E7–27). —— (*ibid.*, 277–278); Standard [A.S.T.M.] Methods of Verification of Testing Machines (E4–36). —— (*ibid.*, 287–295); Standard [A.S.T.M.] Methods of Tension Testing of Metallic Materials (E8–46). —— (*ibid.*, 296–307); Standard [A.S.T.M.] Method of Test for Brinell Hardness of Metallic Materials (E10–

27). —— (*ibid.*, 308–313); **Standard [A.S.T.M.] Methods of Test for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials (E18–42).** —— (*ibid.*, 314–323); **Standard [A.S.T.M.] Method of Bend Testing for Ductility of Metals (E16–39).** —— (*ibid.*, 327–328); **Standard [A.S.T.M.] Definitions of Terms Relating to Methods of Testing (E6–36).** —— (*ibid.*, 329–333); **Standard [A.S.T.M.] Definitions of Terms Relating to Rheological Properties of Matter (E24–42).** —— (*ibid.*, 334); **Standard [A.S.T.M.] Definitions of Terms Relating to Heat-Treatment of Metals (E44–43).** —— (*ibid.*, 335–339).

XXIII.—MISCELLANEOUS

Aluminium Developments. Some Aspects of Progress. S. A. J. Sage (*Metallurgia*, 1947, **35**, (208), 193–196; correspondence, (210), 297).—War-time technical progress in the extraction and fabrication of aluminium is reviewed. It was found possible to produce aluminium of 99·997% purity for high-strength alloys, of which new varieties were developed. These could be clad with high-purity aluminium or a 1%-zinc alloy, to prevent corrosion. Other notable developments were in the field of surface finishing, X-ray inspection technique, and rolling.—M. A. V.

Digest of Specifications for Zinc and Zinc Alloys. Robert S. Burpo, Jr. (*Materials and Methods*, 1947, **25**, (1), 117).—Data sheet.—J. L. T.

***An Illusion of Size [of Metallic Coins].** Robert Weil (*Phil. Mag.*, 1947, [vii], **37**, (272), 643–648).—According to Loewenstein (*Nature*, 1945, **155**, 672), bright and dull threepenny pieces appear to differ in size, the duller being the larger. A white background is said to invert the phenomenon, while a dark or neutral background shows it more clearly. Hartridge (*Nature*, 1945, **156**, 118) suggested a physical explanation, and criticized interpretations based on psychological grounds. The effect is examined for different coins under different conditions of illumination, background, surface condition, &c., using a number of independent observers. It is improbable that the effects can be explained by considering the way in which the edges of the coin enter into the problem, and Loewenstein's suggestion of a psychological basis for the phenomenon must be considered further.—W. H.-R.

Metals, Minerals, and Research. Clyde Williams (*Trans. Canad. Inst. Min. Met.*, 1947, **50**, 131–137 (in *Canad. Min. Met. Bull.*, 1947, (**419**)); and *Min. and Met.*, 1947, **28**, (483), 140–143).—An address. W. reviews metallurgical advances made during the war and emphasizes the importance of research in the future.—N. B. V.

Industrial Research. (Sir) Clifford Paterson (*Engineer*, 1947, **183**, (4755), 215).—A speech at the 1947 annual luncheon of the Parliamentary and Scientific Committee.—J. L. T.

The Metallurgist Aids the Chemist. L. Sanderson (*Machinery Lloyd*, 1946, **18**, (24), 103–105).—S. summarizes many war-time developments, including the development of a new gas-turbine alloy containing chromium 33·3, molybdenum 30·8, and iron 35·9%. Zinc in contact with steel at high temp. causes rapid corrosion. Pliability of hot-dipped zinc coatings on steel is improved by an initial roughening of the steel surface. A brilliant multi-coloured electroplate has been obtained from a solution of 20 g./l. ammonium molybdate with 1 g./l. sodium cyanide. Adhesion of tin bearings is improved by the initial tinning of the steel backing piece with a solid solution of tin–antimony compound in lead, which is capable of dissolving up to 7% iron.

—H. Pl.

Isotopes in Chemistry and Metallurgy. Hugh S. Taylor (*Metal Progress*, 1946, **49**, (6), 1207–1208).—Urey's discovery of the heavy isotope of hydrogen led to rapid developments in this field, 277 stable isotopes, 9 naturally occurring

radio-elements, and 370 isotopes in which the product nucleus was not stable having been observed by 1940. Large-scale separation of isotopes of both light and heavy elements was achieved during the war on an industrial scale, and the corresponding separations of intermediate stable isotopes should also become practicable. Neutrons, now available as a result of nuclear-fission processes, may in future be used for the bombardment of atoms. Applications of isotopes include: (1) the elucidation of the mechanism of the ammonia synthesis and of the role of catalysts in synthesizing hydrocarbons; (2) the use of radio-active isotopes in tracer techniques, e.g. in investigating reactions between gases and solids, grain-growth, diffusion through lattices and along crystal boundaries, alloy structures, &c.; (3) in industrial analysis, especially in automatic and recording methods, problems of fuel flow, and low-pressure work, e.g. in tracing leaks.—P. R.

Physics; Aeronautical Investigations; Industrial Chemistry; Radio-Physics; Lubricants and Bearings; Building Materials Research; Other Investigations. —— (*19th Ann. Rep. Council Sci. Indust. Research, Australia*, **1945**, 90–128).—A statement is made of all the researches conducted for the Australian Council for Scientific and Industrial Research during 1945, and accounts are given of work in progress. No detailed results are given, but a *bibliography* dealing with the results of the research is included.—H. J. A.

Autumn Meeting of the Société Française de Métallurgie (Paris, October 1946). —— (*Tech. Moderne*, 1947, **39**, (5/6), 101–104).—Summaries of these papers are given: *A. Jaquerod*, "Deviations from Hooke's Law; a Method to Determine Them Experimentally"; *L. Guillet*, "Influence of Structure and Chemical Composition on the Damping Capacity of Some Copper Alloys"; *P. Lacombe*, "On a New Method of Preparing Single Crystals of Super-Purity Aluminium"; *P. Lacombe* and *L. Beaujard*, "Contribution to the Micrographic Study of the Hardening and Recrystallization of Super-Pure Aluminium"; *J. Hérenguel*, "Study of the Intergranular Cohesion of Al–Zn–Mg Alloys. Its Relation to Corrosion under Tension"; *P. Morize, P. Lacombe*, and *G. Chaudron*, "The Physico-Chemical Properties of Electrolytically Polished Surfaces"; *L. Jenicek*, "Experimental Study of Metallic Diffusion by the Thermomagnetic Method"; *M. Paič*, "X-Ray Study of the Structure of Al–Pb and Al–Pb–Mg Alloys".—J. L. T.

New Metals for Old. (Sir) Edward Appleton (*J. Inst. Brit. Found.*, 1947, **1**, (5), 40–42; also *Found. Trade J.*, 1947, **82**, (1608), 185–191; and *Engineering*, 1947, **164**, (4251), 69; (4252), 90–91).—The 1947 Edward Williams Lecture to the Institute of British Foundrymen.—J. E. G.

Presidential Address [to the Institute of British Foundrymen]. Percy H. Wilson (*Found. Trade J.*, 1947, **82**, (1607), 163–166; and *Engineering*, 1947, **164**, (4250), 30–31).—J. E. G.

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*British Intelligence Objectives Sub-Committee. *Degussa Sodium Production, Using Downs' Cells.* (F.I.A.T. Final Report No. 820.) [Mimeographed.] Cr. 4to. Pp. 17. 1947. London: H.M. Stationery Office. (2*s.* 2*d.*, post free.)

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***British Intelligence Objectives Sub-Committee.** *Metallurgical Examination of a Type 91, Change 3, 18-Inch Japanese Torpedo by L. H. Grenell, J. R. Cady, J. G. Dunleavy, and H. W. Gillett, Battelle Memorial Institute.* (Report No. B.I.O.S./J.A.P./P.R./1446.) [Mimeographed.] Cr. 4to. Pp. 54, with 28 illustrations. 1947. London: H.M. Stationery Office. (9*s.* 2*d.*, post free.)

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XXV.—BOOK REVIEWS

Introduction to Electron Optics. The Production, Propagation, and Focusing of Electron Beams. By V. E. Cosslett. Med. 8vo. Pp. xii + 272, with 155 illustrations. 1946. Oxford: Clarendon Press. (20*s.* net.)

In these days, it is impossible to wander very far afield in Research or Industry without coming across some electronic device or other doing very useful work. The appearance of a book of this type about electron optics is therefore to be sincerely welcomed. When reviewing a book for a metallurgical journal, the reviewer is expected to indicate whether it is a good book, and whether it is of primary interest to the bulk of the metallurgical profession. The answers to these two questions in the present case are respectively "Yes" and "No". The book is written primarily for students of physics, and is based upon a series of lectures given at Oxford to undergraduates in their final year of the Honour School of Physics. The treatment is

intermediate between that usually adopted in the most comprehensive treatises, and that found in short monographs for readers who are already familiar with the fundamentals of the subject, and thus fills a gap in the literature previously available to students. Though not excessively mathematical, the book assumes a good grounding in the calculus.

In the first 147 pages, the fundamentals of the theory of electron motion in electromagnetic and electrostatic fields are carefully and adequately presented. The characteristics of the electromagnetic and electrostatic lenses are discussed, and methods of calculating the field distribution in such lenses, and the path of an electron subject to these fields, are given. Except for relatively simple cases, the mathematics is prohibitively complicated, so that use must be made of experimental measurements with models such as the electrolytic trough and the gravitational model, which are interestingly described. Electromagnetic and electrostatic focusing are considered in detail, together with the determination of focal lengths.

Images formed by electron lenses are subject to a number of aberrations. The book contains a very clear treatment of the general problem, with specific sections on spherical and chromatic aberrations, distortion, curvature of the field and astigmatism, and coma; there is a brief discussion of the problem of correction. To each chapter is appended a *bibliography* for the student who wishes to go into the subject more deeply.

The remainder of the book (some 120 pages) is devoted to a description of a selection of the many modern industrial and research appliances which rely on electron optics, including the electron microscope, electron-diffraction apparatus, and the cathode-ray tube Here the treatment appears to be occasionally too superficial, but the text is interesting throughout. The reader who is not too up to date in his knowledge of the junior members of the "thingummytron" family will be introduced to several of them here. The reviewer must confess (though hardly with shame, since it does not sound too respectable) that he himself had never met the "Rhumbatron". Devices used in radar and television are also included.

An Appendix of 14 pages is devoted to the main principles of the Hamiltonian mathematical methods, since these afford one of the most useful approaches to advanced electro-optical theory.

While the book is really a relatively detailed introduction for the physics student, it is well worth the study of the general scientific reader who has an interest in the subject of electron optics. Research workers in any branch of science who have to employ electronic devices in their work will also find the book useful, though detailed monographs on the use of the more usual electronic tools are in most cases already available.—G. V. Raynor.

Thorpe's Dictionary of Applied Chemistry. Edited by M. A. Whiteley. Fourth edition (revised and enlarged). **Vol. VIII.—Meth.–Oils, Essential.** With an index by J. N. Goldsmith. Med. 8vo. Pp. viii + 679, illustrated. 1947. London: Longmans, Green, and Company, Ltd. (80*s*. net.)

The new edition of "Thorpe", completely rewritten, goes from strength to strength. The present volume will, no doubt, appeal particularly to organic chemists for its masterly monographs on methylanthracene (35 pp.) and naphthalene (176 pp.); but every metallurgical chemist will find the articles on drop reactions in microchemistry and on microchemical operations (by Prof. L. S. Theobald and the late W. F. Boston, respectively) first-rate as authoritative up-to-date surveys of this important field of analysis. The monograph on "minerals and X-ray analysis", by Dr. F. A. Bannister, is a model of conciseness and includes a comprehensive annotated table, compiled from the literature up to the end of 1940, with X-ray data of about 300 minerals. There is an excellent account of the electron microscope by Prof. E. F. Burton, but optical microscopy, somewhat surprisingly, is not treated. Prof. Byron A. Soule, of the University of Michigan, contributes an article on nomenclature and chemical literature which will, it may be hoped, be widely read. The strictly metallurgical entries include articles on molybdenum, "Monel" metal, and nickel, and appear, on the whole, to be adequate; although that on molybdenum is not as up to date as might be expected and contains some loose writing and a few curious statements. It is, for instance, not easy to understand why "rapid heating" should be a characteristic of a molybdenum-wound furnace; and although molybdenum may have been proposed by some early enthusiast for jewellery purposes, it is certainly not generally regarded as a good substitute for platinum. These are very minor matters, however; this is a most excellent volume.—J. C. Chaston