METALLURGICAL ABSTRACTS

(GENERAL AND NON-FERROUS)

1932 MAY Part 5

I.—PROPERTIES OF METALS

(Continued from pp. 209-221.)

The Chemical Nature of the Oxide Layers formed upon the Metals Aluminium, Zirconium, Titanium, and Tantalum by Anodic Polarization. W. G. Burgers, A. Claassen, and J. Zernike (*Z. Physik*, 1932, **74**, 593–603).—The oxide layers formed by anodic polarization on the metals investigated are found, by chemical and X-ray investigations, to be as follows: aluminium in borax–boric acid solutions gives a layer of approximately pure Al_2O_3 crystallizing in the cubic γ-form with relatively small water content; zirconium forms a surface layer of monoclinic ZrO_2; titanium gives tetragonal TiO_2, and tantalum forms a layer of Ta_2O_5.—J. S. G. T.

The Light Metals and their Alloys. E. Giraud (*Rev. Chim. ind.*, 1931, **40**, 325–328).—Discusses the physical and chemical properties of aluminium and the difficulties of securing adherent coats of other metals (especially nickel and chromium) on aluminium articles. The properties of magnesium, beryllium, and lithium, and their chief alloys are discussed.—E. S. H.

Investigations of the Endurance Strength of Free-Transmission Wires. W. Schwinning (*Hauszeit. V.A.W. u.d. Erftwerk A.G. Aluminium*, 1929, **1**, 52–59; and (in abstract) *Z. Metallkunde*, 1929, **21**, 347).—Preliminary account of a paper published later in *Hauszeit. V.A.W. u.d. Erftwerk A.G. Aluminium*, 1930, **2**, 99–130; cf. this *J.*, 1931, **47**, 257–258.—M. H.

Remarks on Bismuthiferous Copper. C. Frick (*Metallbörse*, 1931, **21**, 1395–1396).—The tensile strength, elongation, reduction in area, and electrical conductivity of copper containing 0·005–2% bismuth are shown graphically, and the results are tabulated. Less than 0·01% bismuth in copper renders it hot-short and about 0·05% makes it cold-short. Even mere traces of bismuth appreciably reduce the electrical conductivity of copper. As little as 0·005% may be detected in the microstructure.—A. R. P.

The Melting Point of Iridium. — v. Wartenburg, — Werth, and J. Reusch (*Z. Elektrochem.*, 1932, **36**, 50).—The melting point of iridium has for a long time been considered to lie between 2360° and 2350° C. With the accurate determination of the melting point of platinum, and the accurate calculation of the constant C_2 in Wien's equation, it was thought that the melting point of iridium should be about 2440° C. As a result of 50 determinations, it was found that it lay between 2410° and 2460° C., with a mean of $2435 \pm 15°$ C., the constant C_2 being given a value of 1432. According to Wöhler, the temperature range for the melting point of iridium is 2390°–2470° C. with a mean of $2440 \pm 15°$ C. The value taken is therefore 2440° C., with an accuracy of about 25° C. A few per cent. of osmium or ruthenium raise the melting point by more than 100° C.—J. H. W.

On the Highest Permissible Bismuth Content in Commercial Lead. W. Kroll (*Metall u. Erz*, 1932, **29**, 114).—A letter to the editor, pointing out that up to 0·1% bismuth in lead has no deleterious effect when the lead is used in the manufacture of accumulator plates, and that therefore there is no point in paying a premium for electrolytic lead for this purpose.—A. R. P.

Destruction of Lead by Ultra-Radiation. E. G. Steinke and H. Schindler (*Z. Physik*, 1932, **74**, 115–118).—The specific ionization associated with the penetrating ultra-radiation is shown to correspond with that of the H-nucleus with a range of about 10 cm. of lead.—J. S. G. T.

Thermal Expansion of Lead. P. Hidnert and W. T. Sweeney (*Z. Metallkunde*, 1932, **24**, 46).—Cf. this *J.*, 1930, **43**, 405.—M. H.

Further Contributions to the Chemistry of Dvi-Manganese (Rhenium). J. G. F. Druce (*Chem. Weekblad*, 1932, **29**, 57–59).—[In English.] An account of the preparation and properties of rhenium, its oxides, sulphides, and chlorides, and the per-rhenates.—E. S. H.

The Solution of Oxygen in Silver. J. H. Simons (*J. Physical Chem.*, 1932, **36**, 652–657).—Experiments are described which indicate that the oxygen retained by rapidly cooled silver is in the form of silver oxide (Ag_2O). The assumption that the oxygen dissolved in silver occurs as the oxide, and not as atomic oxygen, is used to explain the solution of oxygen in molten and in solid silver. An agreement with experimentally determined solubilities is obtained in the case of molten silver, and the minimum solubility of oxygen in solid silver at 400° C. is explained. The solubility curve of silver oxide in solid silver is calculated.—J. S. G. T.

The Adsorption of Silver Nitrate by Finely Divided Silver. H. V. Tartar and Otto Turinsky (*J. Amer. Chem. Soc.*, 1932, **54**, 580–583).—The results showed no positive adsorption of silver salts from aqueous solution by silver prepared by different methods, and indicate that previous positive results were due to the presence of zinc in the silver used.—R. G.

Preferred Orientation in Silver Foil Produced by Cold-Rolling. Cleveland B. Hollabaugh and Wheeler P. Davey (*J. Rheology*, 1931, **2**, (3), 284–289; discussion, 290–291).—The two preferred orientations of crystals due to cold-rolling of silver foil are investigated and the "degree of preferment" of each orientation is ascertained. These preferred orientations are not affected either by the percentage or absolute reduction of thickness of the foil per pass through the rolls. A more detailed account of the work is published in *Metals and Alloys*, 1930, **1**, 602; see this *J.*, 1931, **47**, 25.—J. S. G. T.

Mechanical Twins in White Tin and Zinc. Kenzo Tanaka and Keiichi Kamio (*Mem. Coll. Sci. Kyōtō Imp. Univ.*, 1931, [A], **14**, 79–83).—[In English.] The orientations of twin bands with reference to the mother crystal were determined in white tin and zinc by means of the Laue photographs. The twinning planes were found to be (331) and (10$\bar{1}$2), respectively.—E. S. H.

The Half-Value Period of Uranium-γ. O. Gratias and C. H. Collie (*Proc. Roy. Soc.*, 1932, [A], **135**, 299–306).—The half-value period of uranium-γ has been found to be $24 \cdot 0 \pm 0 \cdot 58$ hrs. The corresponding value of λ, the decay coeff., is $8 \cdot 02 \times 10^{-6}$ sec.$^{-1}$.—J. S. G. T.

Causes of Defects in Zinc Plates. R. E. Bartuska and E. Zalesiński (*Photographische Korrespondenz*, 1931, **68**, 45–52).—A lengthy abstract of a paper on "The Suitability of Zinc and Zinc Alloys for Chemigraphical Purposes—I," by the same authors in *Z. Oberschles. Berg.-u. Hüttenmänn. Vereins*, 1931, **70**, 308; see *J.*, this volume, p. 148.—A. R. P.

Advances in the Preparation and Uses of Some Rare Elements. Walter Noddack (*Metallbörse*, 1931, **21**, 603–604, 651–652).—Notes on the occurrence, preparation, and properties of lithium, beryllium, cerium, germanium, hafnium, tungsten, and rhenium.—A. R. P.

Report of Joint Research Committee on Effect of Temperature on the Properties of Metals. Progress Report to the Sponsor Societies. H. J. French and N. L. Mochel (*Proc. Amer. Soc. Test. Mat.*, 1931, **31**, (I), 106–109).—See this *J.*, 1931, **47**, 422.—S. G.

Report of Committee III [of A.S.T.M.] on Projects and Work. L. W. Spring (*Proc. Amer. Soc. Test. Mat.*, 1931, **31**, (I), 110–113).—Cf. preceding abstract.—S. G.

Report of Research Committee [of A.S.T.M.] on Fatigue of Metals. H. F. Moore (*Proc. Amer. Soc. Test. Mat.*, 1931, **31**, (I), 249).—See this *J.*, 1931, **47**, 372.—S. G.

Discussion on Fatigue of Non-Ferrous Metals. W. H. Bassett. J. B. Kommers (*Proc. Amer. Soc. Test. Mat.*, 1931, **31**, (1), 257–258).—Lead in Muntz metal makes the alloy cold-short, reduces the shear stress considerably, and results in low elongation values. The proof stress of brass is taken as the unit stress at which a permanent set of 0·00005 in. is obtained, and is a much more delicate measure of elasticity than is the usual "elastic limit." In determining proof stress repeated loadings improve the elasticity, so that the values for proof stress are higher than those for proportional elastic limit; annealing at 275° C. has a similar effect in improving the elasticity.—A. R. P.

The Phenomenon of Slip in Plastic Materials. A. Nádai (*Proc. Amer. Soc. Test. Mat.*, 1931, **31**, (1), 11–46).—Sixth Edgar Marburg Lecture. Recent work on the phenomena which occur when metals, minerals, and rocks are subjected to severe plastic strains and deformation is reviewed, and the mathematical laws governing the formation of deformation patterns on the surface of stressed materials are discussed.—A. R. P.

A Simple Model Explaining the Hardening Effect in Polycrystalline Metals. H. Hencky (*J. Rheology*, 1932, **3**, (1), 30–36).—Strain-hardening observed in polycrystalline metals is also present in the elastic state, but is hidden by the relatively large value of the shear modulus. A possible simple microstructural model, showing the features observed in tension and compression tests and which may be applied to explain the Bauschinger effect and brittleness after plastic strain, is suggested and discussed mathematically.—J. S. G. T.

Measurements of the Pressure-Flow of Metals at Low Temperatures. R. Holm and W. Meissner (*Z. Physik*, 1932, **74**, 736–739).—Measurements have been made of the indentations made in 1 minute in the metals gold, platinum, silver, lead, tin, and copper by a steel sphere subjected to pressure, at temperatures ranging from 20° to 293° abs. If the radius of the indentation under load P is a, then the flow pressure f is given by $P = f\pi a^2$. The value of f is, in general, found to increase considerably with decrease of temperature, most markedly in the case of silver, and less in the case of gold. Work-hardening considerably reduced the value of f at room temperature in the case of gold. —J. S. G. T.

The Production of Specific Tensions by Stretching. V. Caglioti and G. Sachs (*Z. Physik*, 1932, **74**, 647–654).—The development of specific stresses in copper crystals by stretching is investigated by X-ray analysis. The values of the specific stress in the respective cases of a single-crystal and polycrystalline material are found to be 6 kg./mm.^{2} and 13 kg./mm.^{2}, which are respectively about 1/3 and 1/4 the applied tensions. The anticipated maximum values are about double these values. The respective increases of internal energy are about 0·004 kg.mm./mm.^{3} and 0·02 kg.mm./mm.^{3}. These values are less than 0·1% of the work done in the extension.—J. S. G. T.

The Law of Elasticity for Isotropic and Quasi-Isotropic Substances by Finite Deformations. H. Hencky (*J. Rheology*, 1931, **2**, (2), 169–174; discussion, 174–176).—Hooke's law concerning the proportionality of stress and strain is not valid for finite deformations. A law containing Hooke's law as a special case is deduced mathematically, and is found to afford analytical results agreeing with results obtained by Bridgman for the compressibility of solids, liquids, and gases. Moduli of compression and a hypothetical limiting relative volume are tabulated.—J. S. G. T.

Experimental Investigations Relating to the Dependence of the Tensile Stresses on the Rate of Strain. H. Deutler (*Physikal Z.*, 1932, **33**, 247–259). —An experimental investigation of the dependence of the tensile stresses in iron and copper on the rate of strain confirms Prandtl's theory of the phenomenon.—J. S. G. T.

Influence of Temperature upon the Diffusion Coefficient of Solid Metals. Chujiro Matano (*Mem. Coll. Sci. Kyōtō Imp. Univ.*, 1931, [A], **14**, 123–130).—

[In English.] Cf. this *J.*, 1931, **47**, 71, 475. The coeff. of diffusion D have been determined from the electrical resistance at various temperatures of foils composed of thin layers of 2 different metals, using the relation $Dt =$ const. for the same kind of foils, where t is the time interval which is required to bring the resistance to some fixed value. It is confirmed that $D = Ae^{-\alpha/\theta}$, where A and α are constants and θ is the absolute temperature, for the systems silver–gold and nickel–copper between 300° and 500° C.—E. S. H.

A Precision Method for Determining the Thermal Diffusivity of Solids [Nickel]. Richard H. Frazier (*Phys. Rev.*, 1932, [ii], **39**, 515–524).—If a rod of uniform cross-section, initially in thermal equilibrium, has the temperature at one end suddenly changed, and maintained at a slightly different temperature, the subsequent change in temperature distribution along the rod is given by an exponential expression involving the time and the thermal diffusivity, *i.e.* the ratio of the thermal conductivity to the product of the sp. heat and density. The theory is developed, and an apparatus is described in which the temperature difference between two points in a metal rod under these conditions is used to generate an e.m.f. in a thermocouple by soldering fine wires into two small holes in the test-piece which is mounted in an evacuated space. The temperature of one end of the specimen is suddenly changed by a stream of water, and measurements of time and galvanometer deflections enable the thermal diffusivity to be obtained to within 0·1%. Tests with nickel are described.—W. H.-R.

The Resistance and Development of Crystal Nuclei above the Melting Temperature. William T. Richards (*J. Amer. Chem. Soc.*, 1932, **54**, 479–495).—The work of Tammann is discussed, with the various explanations to account for the effect of treatment of a liquid previous to undercooling on the crystallization frequency. An hypothesis is put forward, based on the reasonable assumption that the entropy change of the transition from free liquid to free crystal is not greatly different from that of adsorbed liquid to adsorbed crystal, and the postulate that in certain cases the heat of adsorption of the crystalline adsorbate is greater than that of the liquid. If the adsorption space contains the crystalline modification, its heat of adsorption will, in effect, be added to the melting heat of the free crystal in opposing the destruction of the lattice by thermal agitation, and the melting temperature of the crystalline adsorbate will be above that of the pure crystal. The crystalline arrangement may, therefore, persist above the ordinary melting point of the solid, and grow into the liquid if the temperature is lowered. Applications of this hypothesis to purification of materials and treatment of glasses and alloys are indicated.—R. G.

Crystallization of Metals and Alloys under Pressures up to 20,000 Atmospheres. G. Welter (*Przegląd Techniczny*, 1931, **70**, (8), 153–157).—See this *J.*, 1931, **47**, 573.—Z. J.

Registration of Cathode Rays by Thin Films of Metals and Metal Compounds. Warren W. Nicholas and C. G. Malmberg (*U.S. Bur. Stand. J. Research*, 1932, **8**, 61–65; *Research Paper* No. **400**).—A search was made for a method of registering cathode rays analogous to the photographic method which could be carried out entirely in daylight and in which no development process would be required. For this purpose, thin metal films (lead, silver, bismuth, tin, cadmium, arsenic, copper, antimony, zinc, magnesium, selenium) were deposited on glass by evaporation from a coiled tungsten filament in vacuum. These were then exposed, *in vacuo*, to a beam of 10 kv. cathode rays. Films of lead and tin, so thin as to be quite transparent before exposure, were darkened to a density of the order of 0·5 by exposure to 0·01 coulomb/cm.^{2}. Also opaque films of the above metals were exposed to the vapours of various acids (hydrochloric, nitric, hydrobromic, hydriodic, hydrogen sulphide, sulphuric); this generally produced a lowered opacity, in many cases the films becoming quite transparent. Exposure to cathode rays tended to restore the original opacity. In general, the best effects were obtained with nitrates and bromides; bismuth nitrate seemed to show the most promise as to sensitivity and permanence of record. The cathode-ray bombardment caused practically all the films to fluoresce, the colour and intensity of the fluorescence depending on the material.—S. G.

On a New Method for the Determination of the Heat Conductivity of Metals. Fritz Gabler (*Sitzungsber. Akad. Wiss. Wien*, 1931, **140**, [IIa], 433–451).—Test-pieces of equal dimensions and surface (which is gilded) are heated electrically at both ends by means of resistance coils and longitudinally by means of the Joule effect of a current. By suitable selection of both methods of heating, the temperature of the rods can be kept constant in an axial direction, and thus the rate of heat transfer can be measured. In a second test, the temperature of the middle of the rod is varied from that at the ends, and from the heat transfer equation obtained in this test the heat transfer value is calculated, subtraction of which from the value obtained in the first test gives the heat conductivity. For nickel the results were correct within 3·5% and for copper within 1%.—A. R. P.

Superconductivity [of Tin] with Respect to Alternating Currents. F. B. Silsbee, R. B. Scott, J. W. Cook, and F. G. Brickwedde (*Phys. Rev.*, 1932, [ii], **39**, 379–380).—A note. The resistance of tin foil has been investigated at the temperatures of liquid helium under d.c. and under a.c. of frequencies 60, 2640, and 1,410,000 cycles per second. Whenever the specimens were superconducting to d.c., the resistances to the 60- and 2640-cycle currents were too small to be measured. With the radio frequency current (1,410,000 cycles) an abrupt increase in current was noted on cooling through the critical temperature, and when d.c. and a.c. were superposed, the discontinuity appeared simultaneously in both currents. This confirms the later work of McLennan (*Trans. Roy. Soc. Canada*, 1931, **25**, 191), and throws doubt on the earlier paper of McLennan, Burton, Pitt, and Wilhelm (*Phil. Mag.*, 1931, [vii], **12**, 707; see this *J.*, 1931, **47**, 641), which claimed that lead did not become superconducting under a.c. of frequency 10^7 cycles per second.—W. H.-R.

Preliminary Wave-Mechanics Contribution to the Theory of Super-Conduction. R. Schachenmeier (*Z. Physik*, 1932, **74**, 503–546).—A wave-mechanics theory of electrical conduction in metals is developed. The theory indicates that electrons pass without being scattered through the thermally agitated lattice, effecting a secular exchange between conduction- and series-electrons. The sudden change of resistance occurring at the temperature of incidence of superconduction is explained, and fair agreement is found between the theoretical and experimental values of this critical temperature in the case of lead.—J. S. G. T.

On the Electric and Photoelectric Properties of Contacts between a Metal and a Semi-Conductor. J. Frenkel and A. Joffé (*Phys. Rev.*, 1932, [ii], **39**, 530–531).—A note. By treating a semi-conductor as a metal with relatively few free electrons per unit volume, expressions are deduced for the resistance between a metal and a semi-conductor. The contact is regarded as a gap through which the electrons pass according to the laws of wave-mechanics (cf. Frenkel, *Phys. Rev.*, 1930, [ii], **36**, 1604; see this *J.*, 1931, **47**, 136). The equations express a high rectification effect in the direction metal–semi-conductors, but at higher temperatures this disappears. The illumination of this kind of contact produces an abnormal photoelectric effect in which electrons flow from the semi-conductor (*e.g.* Cu_2O) to the metal (*e.g.* Cu), and this is discussed.—W. H.-R.

II.—PROPERTIES OF ALLOYS

(Continued from pp. 221–228.)

Tensile Strength and Electrical Conductivity of Wires of Pure Aluminium and Aluminium Conducting Alloys Depending on Mechanical and Thermal Treatment. H. Bohner (*Hauszeit. V.A.W. u.d. Erftwerk A.G. Aluminium*, 1929, **1**, 12–30).—A study was made of the change in tensile strength, electrical conductivity, and microstructure of rolled wires (of various diam.) of commercial aluminium (98·23–99·69%), Aldrey, Telektal (iron 0·48, silicon 1·58, lithium 0·08%), and 4 aluminium–copper, aluminium–silicon, and aluminium–copper–silicon alloys by cold-drawing, quenching at 520°–540° C., cold-drawing, and subsequent annealing at 120°–180° C. (depending on time of annealing), quenching at 520°–540° C., and subsequent ageing for 48 hrs. at 120°–180° C. Results are tabulated, shown diagrammatically, and discussed from the point of view of the value of these alloys as materials for overhead transmission cables.—M. H.

Aluminium–Chromium Alloy. Anon. (*Aluminium Broadcast*, 1930, **2**, (19)).—The development of an aluminium–chromium alloy having a tensile strength of 30–40 kg./mm.^{2} is reported from Sweden.—J. C. C.

[M.G. 7] New Aluminium Alloy. Anon. (*Electrician*, 1932, **108**, 40–41).—See *J.*, this volume, p. 76.—S. V. W.

Aluminium–Silicon Alloys: their Properties and Some Applications. R. B. Deeley (*Met. Ind.* (*Lond.*), 1932, **40**, 273–276).—Read before the Scottish Local Section of the Institute of Metals. The effect of "modification" and some of the agents used to produce it are described, and the various hypotheses put forward to account for the mechanism of the phenomenon are discussed. The ratio of the tensile strength of sand-cast to chill-cast bars of various aluminium alloys, including both modified and unmodified aluminium–silicon alloys, lies between 0·6 and 0·82, and the initial and final freezing points have a range of difference of from 2° C. for the unmodified 12% silicon alloy to 137° C. for the "Y" alloy. The amount of impurity required to reduce the elongation of the aluminium–silicon alloys by 50% ranges from 0·2% for calcium and titanium to 4·5% for zinc. The aluminium–silicon alloy has practically no hot-shortness, which corresponds with its very small solidification interval. The principal mechanical properties of 6 aluminium alloys, both chill- and sand-cast, are tabulated.—J. H. W.

Silumin in the Chemical Industry. Anon. (*Aluminium Broadcast*, 1930, **2**, (29), 20–27).—Translation of a publication of Metallgesellschaft A.G. The properties and uses of Silumin are summarized, a special feature being the inclusion of tabulated figures indicating the rate of its corrosion attack by a wide variety of organic and inorganic substances. These tables are compiled mainly from the literature, but contain a certain amount of original data. —J. C. C.

The Light Metals and their Alloys. E. Giraud (*Rev. Chim. ind.*, 1932, **41**, 9–12, 41–46).—A discussion of the properties of alloys of aluminium with copper, silicon, nickel, magnesium, manganese, chromium, and beryllium, and of methods of casting.—E. S. H.

Aluminium Alloys. F. Keller (*Metal Stampings*, 1932, **5**, 93–96, 129–130).—The composition of the more important aluminium alloys and the characteristics which determine their use in blanking, drawing, and other forming operations are discussed and the mechanical properties of some sand-cast and wrought aluminium alloys are compared graphically.—J. H. W.

Aluminium Alloys Containing Beryllium. G. Masing and L. Koch (*Z. Instrument.*, 1932, **52**, 97).—An abstract from *Wiss. Veröff. Siemens-Konzern*, 1931, **10**, (2), 15–24; see this *J.*, 1931, **47**, 480.—E. S. H.

Alloying of Beryllium with Calcium and Magnesium. W. Kroll and E. Jess (*Z. Instrument.*, 1932, **52**, 97).—An abstract from *Wiss. Veröff. Siemens-Konzern*, 1931, **10**, (2), 29–32; see this *J.*, 1931, **47**, 480.—E. S. H.

Alloys of Beryllium with Iron. W. Kroll (*Z. Instrument.*, 1932, **52**, 97).—An abstract from *Wiss. Veröff. Siemens-Konzern*, 1931, **10**, (2), 33–34; see this *J.*, 1931, **47**, 480.—E. S. H.

Report of Committee A 10 [of A.S.T.M.] on Iron–Chromium, Iron–Chromium–Nickel, and Related Alloys. Jerome Strauss and H. D. Newell (*Proc. Amer. Soc. Test. Mat.*, 1931, **31**, (I), 246–248).—See this *J.*, 1931, **47**, 429.
—S. G.

Further Studies on Chromium–Nickel–Iron and Related Alloys. Vsevolod N. Krivobok, E. L. Beardman, H. J. Hand, T. O. A. Holm, A. Reggiori, and R. S. Rose (*Min. and Met. Investigations Bull.* (*Carnegie Inst. Technology, Pittsburgh*), No. **103**, 1931, 1–40; *C. Abs.*, 1932, **26**, 67–68).—See abstract from another source, *J.*, this volume, p. 77.—S. G.

Everdur, a Copper Alloy with High Mechanical Strength and Great Resistance to Corrosion. L. Girola (*Met. italiana*, 1931, **23**, 383–389).—A review.
—S. G.

Avialite [Copper–Aluminium Alloy]. Anon. (*Aluminium Broadcast*, 1930, **2**, (26), 19).—Avialite, made by the American Brass Co., is a 90 : 10 copper–aluminium alloy, containing 0·5% of iron, and intended for valve seats and similar inserts in aircraft engine cylinder heads. Its coeff. of thermal expansion is similar to that of the aluminium alloy from which the cylinder heads are cast.—J. C. C.

P.M.G. Alloy. W. Machin (*Met. Ind.* (*Lond.*), 1932, **40**, 201–202).—The mechanical properties of P.M.G. alloy are described. This alloy is a gun-metal in which the tin is replaced by a special hardener. The alloy was first heated to 900° C. and then slowly cooled, quenched in water or reheated to 350°, 450°, 550°, or 650° C., and cooled in air, and also heated to 800° C. and so treated. A comparison is made of the mechanical properties of this alloy with those of a gun-metal at 20°, 200°, 250°, 300°, 350°, and 500° C., and the results of mechanical tests of alloys with 1–10% P.M.G. hardener with and without zinc are given. Briefly, the principal mechanical properties of an alloy consisting of copper 88, hardener 10, and zinc 2% are as follows:

	As Cast.	*Forged.*
Yield-point, tons/in.^{2}	10–12·5	20–36
Ultimate tensile strength, tons/in.^{2}	18–26	32–42
Elongation, % on 2 in.	14–24	17–42
Izod impact strength, ft.-lb.	20	36
Specific gravity	8·44	8·44
Brinell hardness	...	135–150

See also following abstract.—J. H. W.

P.M.G. Metal. Walter Machin (*Met. Ind.* (*Lond.*), 1932, **40**, 280).—Letter amplifying the data of test results and mechanical properties of P.M.G. metal, given in *Met. Ind.* (*Lond.*), 1932, **40**, 201. See preceding abstract.—J. H. W.

The Effect of Metallic and Non-Metallic Impurities on Bronzes. Anon. (*Z. ges. Giesserei-Praxis*: *Das Metall*, 1932, **53**, 67).—A pure 90 : 10 bronze has a yield-point of 24·3 kg./mm.^{2}, an elastic limit of 14 kg./mm.^{2}, and an elongation of 16%. Antimony is frequently added up to 1·2%. Up to 0·4% it has no deleterious effects; above this the yield-point and percentage elongation are lowered, whilst the elastic limit is raised with 0·8% antimony. Lead up to 1% raises the yield-point and elongation, and between 1% and 2% lowers them; the elastic limit is scarcely affected. Arsenic is not injurious, except from the point of view of corrosion-resistance. Iron is definitely injurious with as little as 1%. Sulphur forms cuprous sulphide with the copper, and tends to lower the mechanical properties of the bronze. Oxygen unexpectedly tends to improve the mechanical properties. Gas inclusions consist of furnace gases and are due to the use of too high melting temperatures.—J. H. W.

Freezing Temperatures of Casting Bronzes and Red Brass Alloys. O. Bauer and M. Hansen (*Z. Metallkunde*, 1932, **24**, 63).—The liquidus temperatures, temperatures of reactions between crystals and melts, and solidus temperatures have been determined for the following German standardized alloys : 90 : 10, 86 : 14, and 80 : 20 copper–tin alloys; 79 : 8 : 13 and 86 : 10 : 4 copper–tin–lead alloys; 86 : 10 : 4 and 85 : 9 : 6 copper–tin–zinc alloys; 85 : 5 : 10 copper–tin–zinc + lead alloy.—M. H.

Aluminium in Brass. Anon. (*Z. ges. Giesserei-Praxis* : *Das Metall*, 1932, **53**, 126–128).—The effect on the mechanical properties of adding up to 10% aluminium to a 70 : 30 brass, is described. Increasing proportions of aluminium have irregular results on these properties, according to whether more copper or more zinc is replaced by the aluminium, but the tendency is for the yield-point and the elastic limit to be raised and the elongation to be lowered. The deoxidizing power of aluminium is compared with that of other commonly used deoxidizers. The manner in which it acts in this respect and its general effect on brass casting are discussed.—J. H. W.

The Hall Effect in Gold–Silver Alloys. Edmund van Aubel (*Z. Physik*, 1932, **74**, 119).—v. A. directs attention to discrepancies between the recent work of Ornstein and van Geel (*Z. Physik*, 1931, **72**, 488; see *J.*, this volume, p. 35) and results obtained by Smith and by Sedström.—J. S. G. T.

Age-Hardenable Lead–Nickel–Cadmium Alloys. B. Garre and A. Müller (*Z. anorg. Chem.*, 1932, **205**, 42).—The solid solubility of the compound $NiCd_4$ in lead was determined as about 5% at 244° C. (eutectic temperature) and about 0·5% at room temperature. By annealing at 220° C. (1 hr.) with subsequent quenching and ageing at room temperature (4 days) the Brinell hardness of an alloy with 1% $NiCd_4$ is raised from 5 to 7·5.—M. H.

Some Physical Properties of Wiping Solders. D. A. McLean, R. L. Peek, Jr., and E. E. Schumacher (*J. Rheology*, 1932, **3**, (1), 53–74).—The plasticity of solders at wiping temperatures has been determined by compression tests between parallel plates. The character of the flow is found to correspond with a linear relation between shearing stress and a fractional power of the velocity gradient, the relation between the sample height, h, and the rate of compression being given by $dh/dt = kh^b$, where k and b are constants, and b is independent of the test conditions. For viscous materials, $b = 5{\cdot}0$; for most solders $b > 5{\cdot}0$, and increasing values of b are associated with lower temperature gradients of elasticity. The working properties of a solder can be ascertained from the value of b, determined by a plasticity test; in order to be properly wiped, a solder must have a low temperature gradient of plasticity. Segregation is not responsible for porosity of a solder; porosity may be dependent on the particle size of the solid phase at wiping temperatures. The relation of particle size to the wetting power of the liquid phase is discussed.

—J. S. G. T.

Alloys of Iron, Manganese, and Carbon. I.—Preparation of Alloys. Francis M. Walters, Jr. (*Min. and Met. Investigations Bull.* (*Carnegie Inst. Technology, Pittsburgh*), No. **101**, 1931, 1–13; *C. Abs.*, 1932, **26**, 68).—Because of the importance of manganese as an alloying element, a systematic study of the iron–manganese–carbon system was undertaken. The materials used in the preparation of the alloys were distilled manganese and electrolytic iron melted *in vacuo*. The alloys were melted in an induction furnace under argon at atmospheric pressure because of the high vapour pressure of manganese. Commercial argon was purified by passing over red-hot metallic calcium and copper oxide and through absorbents for water and carbon dioxide. The melts were allowed to freeze in the furnace. The crucibles were of C.P. magnesium oxide and were fired in an induction furnace. The melts, if overheated, lost little manganese. More than 20 melts with 0·02% carbon or less were made for from 0 to 100% manganese and about 20 more with various percentages of carbon up to 1·65%. The purification method for inert gases and the apparatus used are discussed.—S. G.

Alloys of Iron, Manganese, and Carbon. II.—Thermal Analysis of the Binary Alloys. Francis M. Walters, Jr., and Cyril Wells (*Min. and Met. Investigations Bull.* (*Carnegie Inst. Technology, Pittsburgh*), No. **101**, 1931, 14–22; *C. Abs.*, 1932, **26**, 68).—The thermal analysis was made on alloys of high purity of iron–manganese with 0–60% manganese in a modified gradient furnace of Rosenhain. The results agree in general with those of previous investigators. The low-temperature transformations were definitely found in alloys with 13–20% manganese on both heating and cooling, and it was established by thermal analysis that the α- to γ-transformation in the 13% alloy takes place above 600° C. From 26 to 60% manganese, no definite thermal disturbance has been detected.—S. G.

Alloys of Iron, Manganese, and Carbon. III.—An X-Ray Study of the Binary Iron–Manganese Alloys. M. Gensamer, John F. Eckel, and F. M. Walters, Jr. (*Min. and Met. Investigations Bull.* (*Carnegie Inst. Technology, Pittsburgh*), No. **101**, 1931, 23–31; *C. Abs.*, 1932, **26**, 68).—A systematic X-ray investigation of low-carbon iron–manganese alloys by the Debye–Hull method confirms, in general, the work of Schmidt and of Öhman. A comparison of cold-worked specimens with others prepared in a manner to avoid cold-working so far as possible showed that the formation of the hexagonal close-packed phase is favoured by stress. In some alloys, this phase appears on quenching, but it is absent when cooled slowly.—S. G.

Alloys of Iron, Manganese, and Carbon. IV.—A Dilatometric Study of Iron–Manganese Binary Alloys. Francis M. Walters, Jr., and M. Gensamer (*Min. and Met. Investigations Bull.* (*Carnegie Inst. Technology, Pittsburgh*), No. **101**, 1931, 32–45; *C. Abs.*, 1932, **26**, 68).—A dilatometer was used in which the specimen can be tested at temperatures from − 200° C. to 1000° C. in a vacuum or in an inert gas. The indications of phase changes observed by thermal analysis have been confirmed and extended. The lattice dimensions were determined for different phases. The low-temperature transformations on cooling of the alloys with 13% or more manganese may be ascribed to the ϵ-phase. A preliminary study of the rate of heating and cooling indicates that this makes little difference in the temperatures at which the transformation begins, but has a marked effect in the transformation range. Apparatus used are described and the curves taken are reproduced. Seven references to the literature are given.—S. G.

The Preparation and Some Properties of the Amalgams of Titanium, Uranium, and Vanadium. R. Groves and A. S. Russell (*J. Chem. Soc.*, **1931**, (II), 2805–2814).—The conditions for the electrolytic deposition of titanium, uranium, and vanadium from aqueous solutions on a mercury cathode have been investigated and the amalgams so formed studied.—S. V. W.

On the Equilibrium Diagram of the Iron–Molybdenum–Carbon System. Takesi Takei (*Kinzoku no Kenkyu*, 1932, **9**, (3), 97–124).—[In Japanese.] The constitution of the range Fe_3C–Fe–Mo–Mo_2C has been studied by means of thermal, dilatometric, and magnetic analyses, as well as by microscopic examination, and the equilibrium diagram has been constructed mainly in accordance with the following experimental observations: (1) a ternary phase ω known as the double carbide is formed by the peritectic reaction melt + $Mo_2C \rightleftharpoons \omega$, and this phase forms eutectics with other binary phases; (2) the γ (Fe) phase is decomposed by the peritecto–eutectoid reaction γ +

$\omega \rightleftharpoons Fe_3C + \alpha (Fe)$; (3) the γ phase never coexists with the ϵ (Fe_3Mo_2 phase); (4) the η (FeMo) phase is decomposed by the eutectoid reaction as in the case of the binary system. Another ternary phase ζ has often been observable in high-molybdenum and high-carbon alloys. This is shown in an appendix. —S. G.

On the Iron–Mercury System, and the Solubility of Nickel in Mercury. Eva Palmäer (*Z. Elektrochem.*, 1932, **38**, 70–76).—The solubility of iron in mercury was determined in the case of amalgamated iron wire, and was found to be about 0·00007% by weight, and to be practically constant between 20° and 211° C. The crystals that were deposited out of the mercury on the electrolytic iron (the so-called iron-amalgam) were found, when separated, to consist, not of a definite compound of iron and mercury, but of pure iron that had been suspended in the mercury. The solubility of nickel in mercury was determined by stirring mercury with nickel wire, and was found to be 0·00014% by weight at 20° C.—J. H. W.

Permalloys. G. W. Elmen (*Bell Laboratories Record*, 1931, **10**, (1) 2–5; *C. Abs.*, 1932, **26**, 65).—For d.c. circuits, a Permalloy of nickel 78·5 and iron 21·5% is very suitable, whilst for a.c. circuits where a high electrical resistivity is also required for the magnetic material, an alloy of nickel 78·5, molybdenum 3·8, and iron 17·7% is used. This latter material must be subjected to a special heat-treatment, which is described. The permeability as a function of temperature for different additions of molybdenum is given in curves.—S. G.

On the Constitution and Method of Treatment of Nickel Matte and Nickel Speiss. W. Guertler and W. Savelsberg (*Metall u. Erz*, 1932, **29**, 84–90).—The ternary systems nickel–iron–sulphur and nickel–iron–arsenic have been investigated analytically and metallographically. Nickel has a greater affinity than iron for both sulphur and arsenic, but once the lowest sulphides or arsenides of both metals have been formed, further addition of sulphur or arsenic combines with the iron rather than with the nickel compounds. The sulphur system contains the compounds $2FeS,Ni_3S_2$ and $2FeS,Ni_2S$, both of which decompose on cooling into a eutectic of FeS and Ni_6S_5 with the liberation of a small quantity of free nickel containing a little dissolved iron. In the arsenic system there are 3 quasi-binary sections, *viz.*, $FeAs–Ni_5As_2$, $Fe_3As_2–Ni_5As_2$, and $Fe_2As–Ni_5As_2$. The first 2 are eutectiferous with a limited range of solid solution, and the third deposits mixed crystals during solidification which decompose into the compounds $2Fe_2As,Ni_5As_2$ and $4Fe_2As,Ni_5As_2$; the double compounds form eutectoids with one another and with Ni_5As_2 and Fe_2As, respectively.—A. R. P.

Heat-Resisting Alloys: I.—Nickel–Chromium and Nickel–Chromium–Iron Alloys. Anon. (*Bureau of Information on Nickel* (*Mond Nickel Co., Ltd.*), **1932**, 3–11).—A comprehensive survey of the properties and applications of nickel–chromium alloys containing up to 90% nickel and 30% chromium, and of nickel–chromium–iron alloys containing between 69·50% and 40·03% nickel, 19·10% and 29·58% chromium, and 9·48% and 40·20% iron is given, the principal mechanical properties being tabulated. A number of references to recent literature on these alloys is given.—J. H. W.

Life of Resistance Wires for Electric Heaters. M. Horioka, K. Yamamoto, and K. Honda (*Res. Electrotech. Lab. Tokyo*, 1931, (307), 1–63; *Power Bibliography*, **1931**, (9), 7).—[In Japanese.] In the artificial life tests conducted by the authors on resistance wires for electric heaters, specimens of B.S. 22, about 15 cm. in length and of various manufacture, were used. The specimens were stretched in the horizontal position and then heated by flowing electric current, the temperature or energy consumption and the hours that elapsed before the wire burned down, being measured. In order to obtain results suitable for actual use, the tests were carried out in saturated brine, and in oxygen, as well as in air. From the test results the following empirical formula is deduced, which signifies the relation between the life of the wire in hrs. L and the initial absolute temperature, K.

$$L = \alpha r_0 (1 - \gamma)^{e - \theta K}$$

in which r_0 is the radius of the wire, and α, γ, and θ are constants depending on the kind of wire. It is found that the life of wire is prolonged approximately 4 or 5 times by lowering the temperature by 100° C. within the range 800°–1300° C. The brine test shows that the wire which has the longer life in air has a rather shorter life in brine. This is due, the authors assert, to the fact that the dissolution of chromium in brine is more rapid than that of the other constituents of the wire.—S. G.

The Alloys of Platinum and Iridium. W. A. Nemilow (*Z. anorg. Chem.*, 1932, **204**, 41–48).—German translation of the paper published in *Ann. Inst. Platine*, **1929**, (7), 13–20; see this *J.*, 1930, **44**, 512.—M. H.

The Hardness, Microstructure, and Coefficient of Electrical Resistance of Alloys of Platinum and Iron. W. A. Nemilow (*Z. anorg. Chem.*, 1932, **204**, 49–59).—German translation of the paper published in *Ann. Inst. Platine*, **1929**, (7), 1–12; see this *J.*, 1930, **44**, 512.—M. H.

Effect of Crystal Size on Physical Properties of Tin-Base Babbitts. Ernest B. Drake (*Metals and Alloys*, 1932, **3**, 77–81).—Photomicrographs of the crystal structure and tables and graphs giving the tensile and compression strengths of an alloy of 85% tin, 7·5% copper, and 7·5% antimony cast from temperatures between 750° and 1000° F. (400° and 540° C.) into moulds heated at 200°–450° F. (93°–232° C.). Crystal size seems to have no effect on hardness, but the ultimate strength decreases slightly with increase in the size of the crystals.—A. R. P.

Some Factors of Solidification in Relation to Metallurgical and Geological Problems. H. C. Boydell (*J. Chem. Met. Min. Soc. S. Africa*, 1931, **32**, 5).—The phenomenon of "liquation" involved in the case of silver–copper alloys is probably explained satisfactorily by the action of surface tension and adsorption. See also following abstract.—E. S. H.

Some Factors of Solidification in Relation to Metallurgical and Geological Problems. S. W. Smith (*J. Chem. Met. Min. Soc. S. Africa*, 1931, **32**, 75–76).—A reply to Boydell (cf. preceding abstract). There is no evidence that there is any appreciable concentration of one constituent in the surface while the mass is still molten, as would be required if Gibbs' relation were applicable. The surface tension of an alloy appears to be an additive property, and there is no known case of a minimum at the eutectic. The probable explanation of the "liquation" of silver–copper alloys is the migration of the primary crystallites which separate at the chilling surface during the interval of time and temperature between the liquidus and the solidus, *i.e.*, the temperatures of initial and final solidification, respectively. The movement may be affected, however, by the differences in surface tension at the interfaces of these solid crystallites and the still liquid matrix under the influence of the temperature gradient.—E. S. H.

Discussion on von Heydekampf's Paper on "Damping Capacity of Materials." R. G. Sturm and others (*Proc. Amer. Soc. Test. Mat.*, 1931, 31, (1), 172–175).—Cf. this *J.*, 1931, **47**, 373. Strain–time curves are shown for a 1·25% manganese–aluminium alloy (A) and for a 10% silicon–aluminium alloy (B) subjected to a constant tensile stress of 80% of the ultimate strength. In both cases creep takes place rapidly in the first few minutes after loading and then gradually decreases. The curve for A becomes almost parallel to the time axis after about 10 minutes, whereas that for B continues to rise for several hours. S. considers that the damping capacity, rate of creep, and effect of speed of testing a material may eventually all be expressed by a common property of the material, for which he proposes the term "dynamic ductility."
—A. R. P.

III.—CORROSION AND PROTECTION

(Continued from pp. 228–236.)

CORROSION

The Behaviour of a Single-Crystal of Aluminium under Alternating Torsional Stresses while Immersed in a Slow Stream of Tap-Water. H. J. Gough and D. G. Sopwith (*Proc. Roy. Soc.*, 1932, [A], **135**, 392–411).—An aluminium single-crystal was subjected to alternating torsional couples equivalent to a nominal shear stress range of ± 0·65 ton/in.^{2} while immersed in a slow stream of tap-water. Final fracture, due to a profuse system of cracks, occurred after 23,704,000 cycles. The microstructure was examined after the following total numbers of millions of stress cycles: 1·142 (first test), 3·601 (second test), 10·000 (third test), 14·635 (fourth test), 23·704 (fifth test). Plastic deformation occurred during the first test, and the observed slip band distribution agreed exactly with that calculated from the resolved shear stress distribution; no slip bands were observed during subsequent tests. A general corrosion "pitting" attack characterized all stages of the tests. Thus "pitting" is considered to be a form of general corrosion attack. In the early stages the frequency of pitting was 10^7 pits/in.^{2} of specimen surface area; as the tests proceeded, the pits increased in size and merged to form larger pits. Even at the end of the experiment, the pit size was not, in general, very great, and the fatigue resistance of the specimen did not appear to have been seriously influenced by the pits. No fatigue cracks radiated from the pits. Corrosion-fatigue failure due to pit formation may have occurred at more advanced stages of the tests. During the later stages there occurred a marked development of the merging of clusters of pits into small holes in regions subjected to high resolved shear stress. The observations suggest that the marked corrosion effects represented the combined effects of general corrosion pitting (not related to resolved stress) and preferential corrosion along the site of previously formed slip bands. This latter effect was the factor of greatest importance in the failure of the specimen. The long and the small cracks developed were in nearly all cases parallel to the traces of the operative slip planes, and were most thickly concentrated in the region of maximum resolved shear stress intensity. Many of the principal cracks terminated in a network of very fine cracks. The conclusion is reached that failure is directly related to the crystalline structure.—J. S. G. T.

The Use of Aluminium in the Chemical Industry. P. Drossbach (*Aluminium Broadcast*, 1930, **2**, (28), 21–27).—Translated from *Hauszeit. V.A.W. u.d. Erftwerk A.G. Aluminium*, 1930, **2**, 39–44. See this *J.*, 1931, **47**, 272.—J. C. C.

The Use of Aluminium for Oil Lease Tanks. II.—Laboratory Tests. Ludwig Schmidt, John M. Devine, and C. J. Wilhelm (*U.S. Bur. Mines, Rept. Invest.* No. **3131**, 1931, 1–16; *C. Abs.*, 1932, **26**, 411).—Cf. this *J.*, 1931, **47**, 556. Low-temperature salt-water corrosion of aluminium was caused primarily by the magnesium chloride and calcium chloride in the brine. Ferrous sulphide and oxygen greatly accelerated corrosion. High-temperature corrosion was caused primarily by the precipitation of bubbles of hydrogen sulphide and carbon dioxide on the surface of the metal, resulting in superheating and corrosion of the metal. Bimetallic corrosion of aluminium–steel contacts is due to the relatively anodic character of aluminium as compared to steel. Such contacts should be avoided. Different grades of commercial aluminium varied in their corrosion-resistance.—S. G.

On the Corrosion of the Condenser Tube and its Protection. T. Koga (*Ohm* (*Japan*), 1931, (203), 429–430; *Power Bibliography*, 1931, (8), 4).—[In

Japanese.] K. classifies the corrosion of condenser tubes as (1) general thinning; (2) dezincification; (3) pitting or attack by deposit; (4) pure erosion; (5) attack by impingement; and (6) splitting or season-cracking. He describes how the composition of the tube material, quality, velocity, and temperature of cooling water, and the construction of the condenser water boxes and circulating pumps affect tube corrosion. After explaining several protective devices which are usually applied, K. points to the Cumberland method as the most effective of those adopted for protection in the power stations situated near the coast of Northern Kyushu. He concludes, from his experience, that the proper surface area of anode cast iron lies between 5 and 6 cm.^{2} per m.^{2} of condenser cooling surface, and that the suitable current density is 30 amp. per 1000 m.^{2} of condenser cooling surface, d.c. voltage ranging from 4 to 10 v. being taken in accordance with the specific resistance of available cooling water.—S. G.

Determination of the Velocity of Dissolution of Different Faces of Copper Single-Crystals. R. Glauner and R. Glocker (*Z. Krist.*, 1931, **80**, 377–390).—A method for determining the relative rates of dissolution of different faces of a crystal in a corrosive solution is described. Experiments were conducted with copper in both inorganic and organic acids, and for the special case of acetic acid + hydrogen peroxide a space-model illustrating the velocity as a vectorial function has been constructed. In most of the corrosive media the (111) face had the greatest and the (100) face the smallest velocity of dissolution, but in certain circumstances the order may be reversed. The influence of impurities in the copper depends to a large extent on the nature of the solution.—E. S. H.

The Corrosion Resistance of the B.N.F.[M.R.A.] Ternary Alloys of Lead in Buildings. F. L. Brady (*Met. Ind.* (*Lond.*), 1932, **40**, 297–298).—The principal ternary lead alloys are the "antimony ternary alloy," containing cadmium 0·25% and antimony 0·50%, and the "tin ternary alloy," containing cadmium 0·25% and tin 1·50%. The chief value of these alloys in buildings is their high strength. Lead used for this purpose is subjected to 2 main types of corrosion: (1) that resulting from contact with lime mortar, concrete, and other lime-containing material, (2) that due to contact with timber or acid soil. Tests have been carried out on specimens of lead and the 2 ternary alloys, totally immersed in lime water, containing 1·51 grm. $Ca(OH)_2$ per litre. Air free from carbon dioxide was bubbled through the solution, the tests being carried out at room temperature. Further details of the method of testing are published in "The Corrosion of Lead in Buildings," *Building Research Tech. Paper* No. **8**, 1930, 1–29 (this *J.*, 1930, **43**, 497). In every case, the specimens lost weight at a constant rate for 24 hrs., but, after a longer period, corrosion products began to be deposited on the sheets in an irregular manner. The apparent rates of loss in weight without cleaning were approximately the same, namely, 0·25 mg./cm.^{2}/hr. Similar tests in acetic acid solutions gave the following results:

	Loss in weight in mg./cm.^{2}.	
	After 400 hrs.	After 192 hrs.
Lead	12·9	8·9
Antimony ternary alloy . . .	12·5	8·2
Tin ternary alloy	12·0	8·2

These results show a slight advantage in favour of the ternary alloys.
—J. H. W.

Orienting Investigations on the Quality of Tinplate Used in Canneries. E. Mathiesen (*Tids. Hermetikind.*, 1931, **17**, (6), 171–176; *C. Abs.*, 1932, **26**, 775).—The results of physical and chemical examinations of several samples of English, German, and Norwegian tinplate are tabulated. Large variations were found in the quality of the steel and the tin coating. German tinplate had a more uniform thickness than English or Norwegian tinplate. Norwegian tinplate had a higher tensile strength than English, but lower than German tinplate. The coating of tin in the Norwegian and German samples was satisfactory, but that of one English sample was not.—S. G.

Some Causes of Failure in Canned Foodstuffs. E. F. Kohman (*Aluminium Broadcast*, 1930, **2**, (18)).—Abstracted from *Packing Gazette*, 1930, April. See also this *J.*, 1930, **44**, 535.—J. C. C.

Effect of p_H on the Corrosion Products and Corrosion Rate of Zinc in Oxygenated Aqueous Solutions. B. E. Roetheli, G. L. Cox, and W. B. Littreal (*Metals and Alloys*, 1932, **3**, 73–76).—Zinc (99·99% purity) is rapidly corroded by aerated solutions of p_H less than 6 or greater than 12·5, owing to the ready solubility of the film of corrosion product and the consequent ease with which fresh corrosive ions can reach the zinc surface. The low corrosion rates in solutions of p_H 6–12·5 are attributed to the presence of dense and adherent protective films. Insoluble corrosion products may deposit on the metal at values down to p_H 5, due probably to the surface layers of solution having a much higher p_H.—A. R. P.

Corrosion of Metals by Milk and its Relation to the Oxidized Flavours of Milk. E. S. Guthrie, C. L. Roadhouse, and G. A. Richardson (*Hilgardia*, 1931, **5**, 425–453; *C. Abs.*, 1932, **26**, 218).—The oxidized flavour of milk is usually due to metal corrosion. This flavour varies in intensity in the different stages of its development as follows: astringent, papery, metallic, and oily, and finally tallowy. By using thin strips of more than 20 metals and alloys in contact with sweet milk the suitability of these metals for milk equipment was ascertained. Copper and copper alloys such as Ambrac, brass, bronze, Monel metal, nickel–brass, and Waukesha metal showed losses in weight when exposed to sweet milk and produced oxidized flavours. Tin-plated copper or copper alloys were unsatisfactory because of the mechanical wearing away of the plating. Chromium-plated copper was less satisfactory in this respect than the tin-plated metal. Pure nickel showed high losses in weight and became badly clouded when kept in contact with milk. The chromium alloys Ascaloy and Enduro A showed little or no loss in weight and remained clear in appearance, but gave slightly oxidized flavours. The chromium–nickel alloys gave the best results of all, and were as satisfactory as aluminium, glass, or enamel. These produced no oxidized flavours. Aeration increased the tendency to the development of oxidized flavours.—S. G.

The Solubility of Metals in Milk. II.—Submerged Corrosion Tests of Various Metals in Milk. H. T. Gebhardt and H. H. Sommer (*J. Dairy Sci.*, 1932, **15**, 42–61).—The procedure adopted by G. and S. for previous work with copper (see *J.*, this volume, p. 25) is used by them to study the effect, on the corrosion of aluminium, nickel, zinc, tinned copper, soldered copper, tinned and galvanized iron, Allegheny steel, stainless steel, Monel metal, brass, and nickel–brass, of the following factors: acidity, dissolved oxygen, temperature, steam sterilization, intermittent exposure, and tarnish. The type of tarnish, developed by steam sterilization and resulting from exposure to the milk in the various tests, is described. It was found that the solution of Allegheny steel, stainless steel, aluminium, and tinned copper is very slight in acid milk at room temperature, and in fresh milk at various temperatures and oxygen contents.—H. W. G. H.

The Corrosion of Metals by Milk. Colin G. Fink and Frederick A. Rohrman (*J. Dairy Sci.*, 1932, **15**, 73–86).—The considerations governing corrosion by milk are discussed with especial reference to the effect of the small amounts of copper which it always contains. This is held to be responsible for the corrosion of nickel by milk, by simple replacement. Various experiments, in which the corrosion is determined by analysis of the milk, are described and it is concluded that nickel corrodes in milk more readily in the absence of oxygen, whilst the reverse is the case for copper. High-chromium–nickel–iron alloys, Hyblum, and chromium-plated copper or nickel are recommended as very resistant.—H. W. G. H.

Cider and Monel Metal. Anon. (*Bottling* (Suppt. to *Brewing Trade Rev.*), **1932**, (31), 13).—An abstract from *Ann. de Brasserie*, **1931**, Nov., p. 427, giving the results of experiments conducted by G. Warcollier with Monel metal wire and sheet and a vessel of the metal autogenously welded. It is concluded that, in practice, the material is not suitable for prolonged storage of cider or apple juice, but may be employed where the cider is not destined to be in long contact with it, *e.g.* for preparation of the fresh fruit and for mains, filters, taps, &c.—H. W. G. H.

Corrosion of Metals by Liquid Iodine and by Moist Iodine Vapour. B. L. Meredith and W. G. Christiansen (*J. Amer. Pharm. Assoc.*, 1931, **20**, 468–469; *C. Abs.*, 1932, **26**, 69).—Clean strips of 6 metals or alloys were submerged in molten iodine at 130° C. for 48 hrs. Other portions were exposed to moist iodine vapour for 72 hrs. at 65°–70° C. The strips were cleaned, weighed, and the loss was calculated in mg./cm.^{2}. In molten iodine the losses were: lead 176; Carpenter steel 0·46; Ascaloy 4·77; Super-Ascaloy 0·65; Allegheny metal 1·49; and Duriron 173·7. The losses on exposure to moist iodine vapour were: lead 0·68; Carpenter steel 13·68; Ascaloy 12·07; Super-Ascaloy 16·07; Allegheny metal 16·82; and Resistal 12·20.—S. G.

Combating Corrosion in the Textile World. Ray Cottrell (*Textile World*, 1931, **79**, 2008–2011; *C. Abs.*, 1932, **26**, 311).—Information is given in tabular form on the uses and corrosive action towards ferrous and non-ferrous metals and alloys and other materials, of chemicals commonly used in textile mills. The chemicals are sulphuric, hydrochloric, acetic, nitric, sulphurous, oxalic, citric, and tartaric acids; sodium and ammonium hydroxides; sodium and potassium carbonates; aluminium, magnesium, sodium, and zinc chlorides; sodium sulphide; sodium, and calcium hypochlorites and liquid chlorine. It is pointed out that the many determining factors for the reaction between the corrosive agent and structural materials, such as temperature, purity of reagents, mobility of corrosive agents, presence of air, &c., make it difficult to include complete information in all cases. To ensure the choice of the best possible product for each particular application, the advantages and limitations should be carefully balanced. Suitable buildings and building materials to house these corrosives are briefly discussed.—S. G.

Removal of Boiler Scale Deposits from Hot-Water Apparatus. Fritz Hinden (*Monats.-Bull. Schweiz. Ver. Gas Wasserfach*, 1931, **11**, 259–260; *C. Abs.*, 1932, **26**, 229).—Experiments were made on the attack of zinc, aluminium, tin, copper, and brass by dilute hydrochloric, dilute formic, and acetic acids as used for scale removal. It is concluded that 8–10% hydrochloric acid is most suitable for copper or brass apparatus; 5–10% formic acid for aluminium or tinned metals; 15% acetic acid for zinc or galvanized iron.—S. G.

New Method for Determining the Corrosion of Metal Sheets by Motor Fuels. —— Wawrziniok (*Aluminium Broadcast*, 1930, **2**, (29), 13–14).—Abstracted from *Hauszeit. V.A.W. u.d. Erftwerk A.G. Aluminium*, 1930, **2**, 65–69. See abstract from *Automobil-tech. Z.*, 1930, **33**, 28–30, 58–60, 112; this *J.*, 1930, **43**, 505.—J. C. C.

The Corrosion of Metals by Tan Liquors. Anon. (*Aluminium Broadcast*, 1930, **2**, (18)).—Abstract from the annual report of the British Leather Manufacturers' Research Association. Samples of various metals and alloys were immersed for 16 days in 50 c.c. of weak suspender liquor and of bleach liquor. The metal contents of the liquors were then determined colorimetrically. Some stainless steels were practically unaffected by either liquor, aluminium was fairly resistant, and copper–aluminium alloys were corroded considerably. Copper, nickel, and their alloys were corroded slightly by the bleach liquor and to a greater extent by the weak suspender liquor.—J. C. C.

Corrosion Phenomena in Ship Construction. M. P. Andreae (*Korrosion u. Metallschutz*, 1931, 7, 125–133; discussion, 133).—Numerous examples of corrosion of copper, bronze, and steel parts of ships' boilers and condensers are described and methods of protection are discussed.—A. R. P.

Report of Committee B-3 [of A.S.T.M.] on Corrosion of Non-Ferrous Metals and Alloys. T. S. Fuller and Sam Tour (*Proc. Amer. Soc. Test. Mat.*, 1931, **31**, (I), 252–253).—See this *J.*, 1931, **47**, 383.—S. G.

Oxygen as a Factor in Submerged Corrosion. Edward C. Groesbeck and Leo J. Waldron (*Proc. Amer. Soc. Test. Mat.*, 1931, **31**, (II), 279–291; discussion, 292–293).—See this *J.*, 1931, **47**, 382.—S. G.

The Physical Chemistry of the Phenomena of Corrosion. Francesco Giordani (*Giorn. chim. ind. applicata*, 1931, **13**, 275–281; *C. Abs.*, 1932, **26**, 69).—A review of the electrochemistry of passivity.—S. G.

Zinc-Free Alloys for Condenser Tubes [Broternal]. Anon. (*Marine Eng.*, 1932, **55**, 99).—A brief description of the properties of a zinc-free ternary alloy containing aluminium developed under the name of Broternal for the manufacture of condenser tubes. It is stated to have a tensile strength of more than 40 tons/in.^{2} and an elongation of more than 20%, and to be resistant to all forms of condenser-tube corrosion, including the severe forms known as air impingement attack and dezincification, this resistance being largely attributed to the formation of a highly tenacious and self-healing protective film, and to the total absence of zinc.—J. W. D.

PROTECTION

Novel Features of the Study of Corrosion and Protection against Corrosion. Jean Cournot (*Bull. Soc. d'Encour.*, 1932, **131**, 113–122).—A summary and discussion of methods of research on the corrosion of metals and alloys. The methods of protection discussed are: (*a*) treatment of the corrosive medium; (*b*) use of homogeneous metals and alloys; (*c*) electrochemical protection; (*d*) protection of the metallic surface (1) by coating with other metals (hot-dipping, mechanical coating, cementation, electro-deposition), (2) by coating with greases, paints, or enamels, (3) by anodic treatment, (4) by chemical treatment such as Parkerizing.—E. S. H.

The Protection of Metals by Metallic Films. Ernest S. Hedges (*Commonwealth Eng.*, 1932, **19**, 251–256).—Reproduced from *Chem. and Ind.*, 1931, **50**, 768–772; see *J.*, this volume, p. 85.—J. H. W.

Report of Sub-Committee VIII [of Committee A 5 of A.S.T.M. on Corrosion of Iron and Steel] on Field Tests of Metallic Coatings. F. A. Hull (*Proc. Amer. Soc. Test. Mat.*, 1931, **31**, (I), 181–210).—See this *J.*, 1931, **47**, 386.—S. G.

Protection of Aluminium and Aluminium Alloys against Sea-Water. Erich K. O. Schmidt (*Korrosion u. Metallschutz*, 1931, 7, 153–158; discussion, 158).—Modern methods of protecting aluminium and its alloys from sea-water corrosion are reviewed and attention is directed to work on the development of resistant alloys (*e.g.* K.S.–Seewasser) and on the effect of heat-treatment on corrosion resistance.—A. R. P.

The Protection of Light Alloys against Corrosion. Marcel Pubellier (*Rev. Aluminium*, 1931, 8, 1601–1608).—Read before the VIe. Salon Nautique International. See *J.*, this volume, p. 162.—J. H. W.

Evaluating Protective Coatings for Light Metals. J. L. McCloud (*Iron Age*, 1932, **129**, 495–496).—Test-bars of 0·012–0·014 in. sheet Duralumin are quenched and aged, and tested for tensile strength and elongation. They are then coated with the desired material and subjected to a salt-spray test with 20% sodium chloride solution. After a given time, they are again tested for tensile strength and elongation, and the effectiveness of the material as a protector against corrosion is evaluated by plotting the loss in strength against the period of subjection to the corroding medium.—J. H. W.

Protection of Aluminium by Anodic Treatment. Joseph Rossmann (*Met. Ind.* (*N.Y.*), 1932, **30**, 51–52, 108–110).—A review of the patent literature. —A. R. P.

The Anodic Treatment of Aluminium. Edwin Joyce (*Brass World*, 1932, **28**, 29–30; discussion, 30–32. Abstract from *Monthly Rev. Amer. Electroplaters' Soc.*, 1932, **19**, (1), 16–22). See *J.*, this volume, p. 234.—J. H. W.

The Effect of Drainage and the Insulating Joint Method for the Prevention of the Electrolytic Corrosion of Underground Metallic Structures. Mosaku Iwasa (*Res. Electrotech. Lab. Tokyo*, 1931, (316), 1–35; *Power Bibliography*, 1931, (12), 8).—[In Japanese.] A theoretical investigation, by using a method of equivalent network, to determine the effect of drainage and insulating joint applied to underground metallic structures for the prevention of electrolytic corrosion caused by electric railways. The conclusions are briefly outlined as follows: (1) the resistance of the leakage path greatly affects the distribution and magnitude of the current in the structures, *i.e.* the region in which leakage current flows out of the structure tends to be concentrated towards the substation end when the resistance of the leakage path is comparatively low; (2) when applied at the appropriate point, the insulating joint effectively reduces the current flowing through the underground structure, and hence its electrolytic corrosion is diminished; (3) by providing the drainage connection at the sub-station end, the electrolytic corrosion within a certain region entirely disappears, whereas the current through the underground structure increases considerably in the parts adjacent to the drainage point. I. shows that the results obtained by the above theoretical consideration are quite in agreement with those obtained by laboratory experiments and routine surveys. —S. G.

The Aluminium Coating of Metallic Surfaces in Molten Mixtures of Aluminium Chloride and Sodium Chloride. V. A. Plotnikov and N. N. Gratzianskii (*J. Chem. Ind.* (*Russia*), 1931, **8**, 829–835; *C. Abs.*, 1932, **26**, 61).—[In Russian.] The best method of coating objects with aluminium is to use a fused mass of the proportions $3AlCl_3 \cdot 2NaCl$ or $2AlCl_3 \cdot NaCl$ in a vessel which has previously been coated on the inside with aluminium. The vessel serves as the anode during electrolysis. At 200° C. and a current density of 1 amp./dm.^{2} an even, homogeneous layer of aluminium 0·08 mm. thick is obtained. During the electrolysis the vessel should be kept covered to prevent loss of ammonium chloride. Tests of corrosion by water vapour and saturated sodium chloride solution show that objects so coated are more resistant than pure sheet aluminium. Metallographic studies show that between the aluminium layer and the iron of the coated object there is an intermediate layer of solid solution of aluminium in iron. This layer is harder than either pure metal. Objects so coated withstand high temperatures better than those which are uncoated, and the aluminium layer has no tendency to scale off.—S. G.

Effects of Carbon and Iron in Blue Powder on Sherardizing. Masawo Kuroda (*Rikwagaku Kenkyū-jo Ihō* (*Bull. Inst. Phys. Chem. Res.* (*Tokyo*), 1931, **10**, 698–702; and (abridgment in English), *Sci. Papers Inst. Phys. Chem. Res.* (*Tokyo*), 1931, **16**, 125–126; *C. Abs.*, 1932, **26**, 62).—[In Japanese.] Tests were made to discover whether or not the addition of carbon or iron had an accelerating effect on sherardizing. The addition of carbon powder to the blue powder is preferable; the iron powder, however, does not accelerate the sherardizing velocity, but is rather harmful. Aluminium and $AlCl_3$ did not give better results.—S. G.

Report of Sectional Committee [of A.S.T.M.] on Zinc Coating of Iron and Steel. J. A. Capp and A. B. Campbell (*Proc. Amer. Soc. Test. Mat.*, 1931, **31**, (I), 238–241).—See this *J.*, 1931, **47**, 385.—S. G.

Wire Galvanizing Processes. Geoffrey K. Rylands (*Wire and Wire Products*, 1932, **7**, 49–51, 56, 57).—Cf. *J.*, this volume, pp. 30–31, 235. Fifth paper of a discussion on "Hot Galvanizing *versus* Electric Galvanizing" between L. D. Whitehead and G. K. Rylands. It is stated that W.'s electro-galvanized coating is not pure zinc and contains non-metallic impurities. The claims for the electro-galvanizing process that the coat is pure zinc, that pure zinc is the best corrosion preventive and is extremely ductile, and that the thickness of the coat is absolutely uniform, are disputed.—J. H. W.

New Flux Simplifies Wire Galvanizing. Anon. (*Wire and Wire Products*, 1932, **7**, 96–97).—The advantages claimed for a new flux, the composition of which is not specified, and the method of using it, are described.—J. H. W.

The Metal Spray Process as a Protection Against Corrosion. Herbert Pauschardt (*Korrosion u. Metallschutz*, 1931, **7**, 139–145; discussion 145).—The spray process may be used for coating articles with metals or alloys having a melting point below 1600° C. For protection of iron against corrosion, cadmium and zinc coatings or zinc and tin coatings in which the pores have been filled by spraying with Bakelite have given good results on large structures exposed to sea air or industrial atmospheres. Sprayed zinc coatings may be rendered more lasting by subsequent spraying with a thin film of mercury which serves to make the coating water-tight. The paper contains details of large-scale corrosion tests and some practical hints in manipulating the apparatus.—A. R. P.

Metallization as a Protective Process. Anon. (*Met. Ind.* (*Lond.*), 1932, **40**, 277–279).—The process of metallization consists of bombarding the surface to be metallized with thousands of tiny particles of metal in the form of a spray, by means of a compressed air "pistol." It is applicable to the coating of any article from celluloid to steel by any metal which can be drawn into a wire and melted in a blow-pipe flame. The surface must be of an open texture and thoroughly clean. Details of the actual process are given, and data of consumption of wire and gases, weight of metal sprayed, and weight of metal deposited per hour, using both coal-gas and hydrogen, in the case of lead, tin, zinc, aluminium, copper, bronze, and brass are tabulated. Recent developments in the way of aluminizing, electrical applications, and ornamental uses are given.—J. H. W.

Aluminized Iron. A. Karsten (*Z. ges. Giesserei-Praxis: Eisen-Zeitung*, 1932, **53**, 121).—A brief account of the process of coating iron with aluminium by means of an electric Schoop metal-spraying pistol.—J. H. W.

IV.—STRUCTURE

(Metallography; Macrography; Crystal Structure.)

(Continued from pp. 237–238.)

Report of Committee E-4 [of A.S.T.M.] on Metallography. C. H. Davis and O. E. Harder (*Proc. Amer. Soc. Test. Mat.*, 1931, **31**, (I), 612–613).—See this *J.*, 1931, **47**, 386.—S. G.

Transformations of Solid Metal Phases. II.—Kinetics of the Fundamental Atomic Principles. U. Dehlinger (*Z. Physik*, 1932, **74**, 267–289).—All X-ray investigations of metallic transformations in single-crystals indicate that such transformations are, at least partly, single-phase phenomena, within individual grains, *i.e.* the initial phase is not destroyed, but is transformed continuously into the final phase. Almost all transformations are characterized by atomic motions of the nature of a process of diffusion; the velocity of this motion is retarded or accelerated in accordance with the value of the free energy associated with the accompanying change of crystal lattice. The relation between the diffusion process and the change of lattice is further conditioned, for example, by the velocity of heating or cooling and with the grain size. In general, the change of lattice occurs more rapidly than the diffusion process takes place; intermediate bodies with new atomic structures, *e.g.* Martensite and the inhomogeneous material AuCu, are so produced. The free energies of these intermediate conditions can be derived from X-ray investigations; the variation of the velocity of transformation with temperature can then be directly deduced. The mechanisms of the separation of pearlite from austenite and of copper from silver are briefly discussed.—J. S. G. T.

On the Formation and External Forms of Segregations in Metallic Solid Solutions. H. Hanemann and O. Schröder (*Z. Metallkunde*, 1931, **23**, 269–273, 297–300).—(1) If in a supersaturated solid solution the atoms of one element A are arranged in the lattice in straight lines which contain no atoms of the other element B and which are also at a maximum distance from atoms of B, then the atoms of A may move freely along these lines during precipitation from the solution. This movement is called "perfusion." The precipitation by perfusion takes place rapidly, is difficult to suppress by quenching, and results in the formation of large crystals in the shape of needles and layers symmetrically disposed to the directions of perfusion. The mechanism of the perfusion process is illustrated in detail with regard to the separation of ferrite crystals in carbon steel (Widmanstätten structure) and α-crystals in ($\alpha + \beta$)-brass. (2) During the breakdown of a solid solution within the lattice of which no atoms of one kind lie in lines allowing perfusion, changes of concentration (segregations) take place solely by place interchange of A and B atoms. It is proposed, with regard to solid solutions, to restrict the general term "diffusion" to this process. Precipitation by diffusion occurs slowly, is easy to suppress by quenching, and results in small crystal segregations, for which the globular form is typical. A number of other forms of segregations by diffusion (pearlite-like segregations, segregations in rows and small sticks, orientated segregations) are illustrated by photomicrographs and explained by special hypothesis. (3) The external shape of segregations from solid solutions depends chiefly on the orientation of the original solution, and not on the self-orientation of the segregations. The mechanism of recrystallization can, however, influence the shape of the segregation. (4) Segregations of α in ($\alpha + \beta$)-brass lie on octahedron planes, whereas segregations of γ in ($\beta + \gamma$)-brass lie along the cube axes.—M. H.

The Arrangement of the Micro-Crystals in Compressed Single-Crystal Plates of Aluminium.—III. Yoshio Fukami (*Mem. Coll. Sci. Kyōtō Imp. Univ.*, 1931, [A], **14**, 97–113).—[In English.] When a rectangular single-crystal plate of aluminium is compressed to an amount varying from 3% to 10% of the original thickness, the axis of the imperfect fibrous arrangement of micro-crystals thus produced is parallel to the direction of flow of the metal. The fibrous arrangement can be classified into four types, according to the initial orientation of the crystallographic axes with reference to the specimen and the direction of flow of the metal. Of these, the most frequent are: (1) The [110] axis is nearly parallel to the longer side of the specimen, the fibrous axis [111] is parallel to the direction of flow of the metal, and thus the (211) plane is nearly parallel to the flat surface of the specimen. (2) The [111] axis is nearly parallel to the longer side, the fibrous axis [211] is parallel to the direction of flow of the metal, and thus the (110) plane is nearly parallel to the flat surface. The relation between the fibrous arrangement caused by this high degree of compression to that produced in rolled foils of aluminium has been examined for both single- and poly-crystalline specimens and has been shown to be practically the same if the direction of flow of the metal on compression is regarded as the direction of rolling.—E. S. H.

The Lattice Spacings of Iron–Aluminium Alloys. A. J. Bradley and A. H. Jay (*Iron Steel Inst. Advance Copy*, 1932, May, 1–19).—The lattice spacings of the iron–aluminium alloys between 0% and 33% (by weight) aluminium was determined by the powder method. In order to obtain photographs of each alloy, giving lines at all possible angles, a whole series of photographs was taken in a circular camera of the Debye type. Heat-treatment consisted of slow cooling from 750° C., and quenching from 1000° C., 700° C., and 600° C. Both annealed and quenched alloys with from 0% to 10% aluminium have a random atomic distribution and show a linear increase in lattice spacing. Annealed alloys with from 10% to 17% aluminium have a constant value for the lattice spacing. The Fe_3Al type of structure exists in this region, emerging from a random arrangement. The lattice spacing of annealed alloys falls slightly from 17% to 20% aluminium and the structure gradually changes to the FeAl type. Quenched alloys differ from annealed alloys beyond 10% aluminium, the lattice spacing continuing to increase up to 14% aluminium, where there is a sudden fall, corresponding with a change from the random state to the FeAl type of structure. The lattice oscillates slightly in value from 14% to 20% aluminium. Both annealed and quenched alloys have the FeAl type of structure from 20% aluminium upwards, but the lattice spacings differ according to the previous heat-treatment. It is suggested that some of the peculiarities in the lattice spacings between 10% and 20% aluminium may be due to a change in the valency of the iron atoms.—J. H. W.

X-Ray Investigation of the Solubility of Silver in Copper. P. Wiest (*Z. Physik*, 1932, **74**, 225–253).—The solubility of silver in copper is found to be greater for single-crystal alloys than for multi-crystalline alloys. The solubility curve for multi-crystalline alloys is found to agree with those obtained by previous experimenters. Diffusion occurs more slowly in single-crystals than in multi-crystalline alloys. Precipitation from supersaturated solutions is characterized in the case of single-crystals, by a gradual transition from the crystal lattice characterizing the higher temperature to that of the annealing temperature. In multi-crystalline alloys both lattices occur together. Single crystals are not, in general, destroyed during the process of precipitation; destruction, when it does occur, is attributable to too great a degree of supersaturation and the development of internal strains accompanying precipitation and conglomeration.—J. S. G. T.

Attempt to Produce Single-Crystals of Binary Intermetallic Compounds. C. Rossi (*Z. Physik*, 1932, **74**, 707).—Attempts to produce single-crystals of copper alloyed with zinc, tin, silicon, and aluminium in various proportions, and of tin alloyed with gold and magnesium, are briefly described. The method employed was that used by Bridgman, *viz.* cooling slowly a mass of the alloys over a range of 50°–100° C. above the respective melting points. In the case of the alloy Cu_2Zn_3 a reasonably good result was obtained.—J. T.

Lattice Constants, 1931. M. C. Neuburger (*Z. Krist.*, 1931, **80**, 103–131; *C. Abs.*, 1932, **26**, 13).—A tabulation, for the elements, of the most reliable X-ray data. Space lattice, space-group, lattice type, calculated density, cell dimensions, and atomic "radius" are given, with references. Additional tables show distribution of elements among lattice types and give formulæ for calculating atomic radius, atomic volume, interatomic distances, and density of packing for the different types of structure.—S. G.

X-Ray Crystal Analysis. G. Cadogan Rotery (*Elect. Rev.*, 1932, **110**, (2824), 48).—Abstract of the report of the X-ray committee of the Department of Scientific and Industrial Research.—S. V. W.

V.—ANALYSIS

(Continued from pp. 238–242.)

Micro-Analytical Methods. M. E. Long and G. W. Leeper (*Chem. Eng. and Min. Rev.*, 1931, **24**, 99–101).—Abstract of a paper read before the Analytical Group of the Victorian Branch of the Australian Chemical Institute reviewing the various methods available for the estimation of minute quantities of metals in various substances.—J. H. W.

Organic Reagents in Inorganic Chemical Analysis. W. Davies and K. N. Welch (*Chem. Eng. and Min. Rev.*, 1931, **24**, 24).—Brief abstract of a lecture delivered before the Melbourne University Chemical Society, describing the use of various organic reagents in the quantitative and qualitative estimation of non-ferrous metals and other substances.—J. H. W.

Some Observations on Reactions between Certain Metallic Ions and the Ammonium Salt of Aurintricarboxylic Acid. John H. Yoe (*J. Amer. Chem. Soc.*, 1932, **54**, 1022–1023).—A brief account of some studies on the use of "Aluminon" reagent, which provides a sensitive test for the detection of aluminium. The reactions with a number of elements are given. Be forms a lake similar in colour to that produced by Al, and the reagent cannot thus be used to distinguish between the two elements. The results of previous workers with "Aluminon" are summarized.—R. G.

An Extension of the Isoamyl Alcohol Separation of the Alkali and Alkaline Earth Metals to the Less Common Alkalis, Lithium, Rubidium, and Cæsium. Herman Yagoda (*J. Amer. Chem. Soc.*, 1932, **54**, 984–988).—The method of separation is described, commencing with the primary separation into 2 groups by the action of isoamyl alcohol in a mixture of the bromides.—R. G.

On the Gravimetric Determination of Beryllium by Means of Guanidine Carbonate and its Separation from $Fe^{\cdot\cdot\cdot}$, $UO_2^{\cdot\cdot}$, $Th^{\cdot\cdot\cdot\cdot}$, $Zr^{\cdot\cdot\cdot\cdot}$, $Tl^{\cdot}$, WO_4'', MoO_4'', VO_4''', CrO_4'', AsO_3''', SbO_3''', and $Cu^{\cdot\cdot}$. A. Jílek and J. Kota (*Coll. Trav. chim. Tchécoslov.*, 1932, **4**, 97–106).—The HCl solution is treated with NH_4 tartrate, rendered neutral to methyl-red by addition of NaOH, and treated cold with a few c.c. of H·CHO, followed by a 4% solution of guanidine carbonate in slight excess. The precipitate affords BeO on strong ignition.—A. R. P.

Germanic Sulphide: Quantitative Conversion of Sulphide to Oxide by Hydrolysis. John Hughes Miller and Abner Eisner (*Indust. and Eng. Chem.* (*Analyt. Edn.*), 1932, **4**, 134–136).—Roasting of GeS_2 to GeO_2 is attended with many difficulties; these may be overcome by hydrolyzing the GeS_2 precipitate to GeO_2 by boiling with H_2O, whereby the GeS_2 slowly dissolves as $Ge(OH)_4$. The solution is then evaporated in a tared basin and the residue ignited at 900° C. and weighed as GeO_2.—A. R. P.

The Determination and Separation of the Rarer Metals from Other Metals. XX.—Determination of Iridium and its Separation from Platinum and Other Metals. Ludwig Moser and Heinz Hackofer (*Monatsh.*, 1932, **59**, 45–60).—*Separation from platinum:* The solution containing H_2PtCl_6 and H_2IrCl_6 is nearly neutralized with Na_2CO_3, 1–1·5 grm. of $NaBrO_3$ are added followed by an excess of NaBr, and the solution is boiled until Br ceases to be evolved, whereby the $Ir^{\cdot}$ is precipitated completely as $Ir(OH)_4$. The precipitate is washed with hot, very dilute NH_4NO_3 solution and heated in H_2 at 160°–180° C. until the paper is thoroughly charred; after cooling in H_2 the carbonized mass is ignited in the air until all C is burnt away, and the residue is then reduced in H_2, cooled in CO_2, and weighed as Ir. Extraction with dilute HNO_3 is advisable to remove adsorbed Na salts. All the Pt and Au remains in the first filtrate; Pd is partly precipitated, but may be removed from the ignited Ir by extraction with dilute aqua regia. *Separation from copper:* In the presence of Ir, Cu is completely precipitated by $NaBrO_3$–NaBr, but it may be removed by extraction with dilute HNO_3 after the preliminary carbonization in H_2. *Separation from iron:* The chloride solution is treated with $C_2H_2O_4$ until yellow, saturated with H_2S, and made ammoniacal, the precipitate of FeS is collected, redissolved in HCl, and reprecipitated, the combined filtrates are evaporated to dryness with $(NH_4)_2S$, the residue is heated to expel NH_3 and extracted with dilute NH_4NO_3 solution, and the insoluble Ir_2S_3 is collected, roasted, reduced to Ir, and weighed.—A. R. P.

Colorimetric Determination of Molybdenum. L. H. James (*Indust. and Eng. Chem.* (*Analyt. Edn.*), 1932, **4**, 89–90).—The method depends on the extraction of the red-coloured compound produced by NH_4CNS and $SnCl_2$ in a solution of MoO_3 in dilute $HClO_4$ by shaking with butyl acetate. Its application to the determination of Mo in steel is discussed.—A. R. P.

The Determination of Potassium by Means of Perrhenium Acid. Hans Tollert (*Z. anorg. Chem.*, 1932, **204**, 140–142).—In the absence of SO_4, K may be precipitated as $KReO_4$ by addition of a small excess of $HReO_4$; the solution is evaporated to dryness, the residue treated with 85–90% alcohol (40 c.c./0·2 grm. $KReO_4$) containing 1 volume-% $HReO_4$, and the $KReO_4$ collected in a porcelain filter-crucible, recrystallized from H_2O and again precipitated as before, then, finally, treated with a little absolute alcohol, dried at 110° C., and weighed.—M. H.

The Determination and Separation of the Rarer Metals from Other Metals. XXI.—Determination of Rhodium and its Separation from Platinum and Other Metals. Ludwig Moser and Hans Graber (*Monatsh.*, 1932, **59**, 61–72).—*Separation from platinum and gold:* This is effected by hydrolysis of the neutral chloride solution by boiling with NaBr and $NaBrO_3$ (see Section XX, abstract above), Rh behaving in the same way as Ir. *Separation from copper:* The solution (200–400 c.c.) is rendered $0{\cdot}1N$ with respect to H_2SO_4, treated with 15 c.c. of $0{\cdot}1M$-$MgCl_2$ solution for every 100 c.c. volume, saturated with H_2S at 100° C., and allowed to cool in the H_2S stream. The precipitate of CuS and Rh_2S_3 is collected and ignited to oxide. The residue is extracted with 1 : 1 HNO_3 on the water-bath to remove CuO, washed, ignited, reduced in H_2, and extracted twice with concentrated HNO_3; pure Rh remains. *Separation from iron:* This is effected by H_2S treatment of the solution after addition of $MgCl_2$.—A. R. P.

Silver in Lead Bullion. Determination by Volumetric Method. W. R. Wagstaff (*Indust. and Eng. Chem.* (*Analyt. Edn.*), 1932, **4**, 51).—The Pb is dissolved in HNO_3 (1 c.c. for each 1 grm. of Pb) and 10 grm. of tartaric acid (to keep Sb in solution). The solution is diluted to 250 c.c. and the Ag precipitated with a slight excess of NH_4CNS. The precipitate is collected, washed, and dissolved in NH_4OH, and the Ag precipitated by addition of HCl until slightly acid. The filtrate from the HCl is diluted to 400 c.c. and titrated with $KMnO_4$.—A. R. P.

Errors Involved in the Determination of Minute Amounts of Sodium by the Magnesium Uranyl Acetate Method. Earle R. Caley (*J. Amer. Chem. Soc.*, 1932, **54**, 432–437).—The direct method may be used satisfactorily for amounts of Na not less than 0·2 mg. For lesser weights smaller volumes of reagent should be used. A more concentrated reagent leads to high results.—R. G.

Rapid Method for the Determination of Sulphur in Brass and Bronze. J. O. Cooney (*Indust. and Eng. Chem.* (*Analyt. Edn.*), 1932, **4**, 33; and (abstract) *Met. Ind.* (*Lond.*), 1932, **40**, 279).—The metal (5 grm. in fine turnings) is dissolved by warming with 60 grm. of $CuCl_2,2NH_4Cl,2H_2O$ dissolved in 200 c.c. of 5% HCl, whereby all the S remains insoluble with the Sb, Bi, and C, probably as Cu_2S. The residue is collected on an asbestos filter, washed with 5% HCl, and dissolved in 1 : 1 HNO_3 with the aid of Br-water. The solution is filtered, and, after addition of 0·5 grm. of $NaHCO_3$, the filtrate is evaporated to dryness, and the residue baked and extracted with dilute HCl. The solution is filtered and the S precipitated as $BaSO_4$. If much Pb is present, pure Zn should be added before the last filtration.—A. R. P.

Determination of Titanium as Dioxide by Means of Guanidine Carbonate in Tartrate Solutions. A. Jílek and J. Koťa (*Coll. Trav. chim. Tchécoslov.*, 1932, **4**, 72–80).—The chloride or sulphate solution containing not more than 0·1 grm. of TiO_2 is treated with 50 c.c. of 2·5% NH_4 tartrate solution, then neutralized to methyl-red by adding KOH. An 8% solution of guanidine carbonate (75 c.c.) is then added, the mixture boiled for 5 minutes, set aside to cool, and filtered. The Ti precipitate is washed with hot 1% NH_4NO_3 and ignited to TiO_2 for weighing.—A. R. P.

The Use of 8-Hydroxyquinoline, Strychnine, and Brucine for the Gravimetric Determination of Vanadium, and of Quinoline for the Separation of Vanadium from Chromium. A. Jílek and V. Vicovský (*Coll. Trav. chim. Tchécoslov.*, 1932, **4**, 1–7).—An acetic acid solution of 8-hydroxyquinoline, strychnine, brucine, or quinoline precipitates V completely from alkali vanadate solutions. Quinoline will also precipitate V from solutions containing chromates. Ignition of all the precipitates in the air affords pure V_2O_5.—A. R. P.

Titration of Zinc with Potassium Ferrocyanide. I. M. Kolthoff and E. A. Pearson (*Indust. and Eng. Chem.* (*Analyt. Edn.*), 1932, **4**, 147–150).—The value of diphenylamine and diphenylbenzidine as indicators in the titration of Zn with $K_4Fe(CN)_6$ has been studied systematically. Direct titration at room temperature or at 50°–60° C. gives good results provided that the reagent is added carefully towards the end of the titration and that, when the first change from purplish-blue to green occurs, at least 1–2 minutes are allowed to elapse to permit the purple colour to reappear before finishing the titration. The solution should preferably be 0·5–1·5N with respect to H_2SO_4 and $(NH_4)_2SO_4$. When 1% diphenylamine is used as indicator, 0·033 c.c. of 0·025M-$K_4Fe(CN)_6$ must be added for each drop of indicator. No correction is necessary when diphenylbenzidine is used as indicator, but the colour changes in this case are not so pronounced. The titration is best carried out as follows: the Zn solution is treated with $(NH_4)_2SO_4$ and H_2SO_4 to give the above normality, 2 drops of 1% $K_3Fe(CN)_6$ and 2 drops of 1% diphenylamine are added, and the solution is titrated at 50°–60° C. with $K_4Fe(CN)_6$ until an excess is present; after vigorous shaking for 1–2 minutes, the liquid is titrated with standard $ZnSO_4$ solution until a sharp colour change from yellowish-green to violet-blue occurs.—A. R. P.

VI.—LABORATORY APPARATUS, INSTRUMENTS, &c.

[See also "Testing" and "Pyrometry."]

(Continued from p. 242.)

The Uses of the Dilatometer. P. Chevenard (*Metallurgist* (Suppt. to *Engineer*), 1932, **8**, 47–48).—A summary of a paper by C. in *Rev. Mét.*, 1931, **28**, 565; see *J.*, this volume, p. 228.—R. G.

Plane-Polarized Light in the Microscopic Investigation of Ores and Metals. Freleigh Fitz Osborne (*Canad. Min. Met. Bull.*, 1932, (237), 1–13).—A discussion of the practical use of plane-polarized light and methods of observation.
—E. S. H.

Meter and Instrument Design. A. C. Jolley (*Electrician*, 1931, **107**, 592–594).—In a general article on the subject, reference is made to the use of various nickel–iron alloys. By using alloys such as Permalloy and Mumetal, supersensitive instruments are being designed. Instruments with very long scales, of good form, are also possible. For instrument transformers these alloys are already finding extensive application.—S. V. W.

Some New Experimental Methods in Ferromagnetism. S. L. Quimby (*Phys. Rev.*, 1932, [ii], **39**, 345–353).—In abstract. Apparatus for the following purposes is described: (1) a furnace and crucible device for preparing single-crystals of nickel by the Bridgman method; (2) fused quartz extensometers for measuring the coeff. of expansion of metal rods, and the variation of Young's modulus with temperature; (3) complex piezo-electric oscillators in which nickel bars are cemented to crystalline quartz. From the vibrations of these, Young's modulus may be determined in the neighbourhood of the Curie point. The rigidity modulus may also be studied by this method, but with single-crystals the free period of torsional vibration depends on the rigidity modulus alone, only if the cylinder axis has certain orientations relative to the crystal axis. The same kind of apparatus can be used to study the internal friction in solids, and the arrangement of the circuit is described.—W. H.-R.

A New Glass or Quartz Mercury Lamp for the Laboratory and Technical Use. W. Harries and A. v. Hippel (*Physikal. Z.*, 1932, **33**, 81–85).—A cheap mercury vapour lamp of high intrinsic brilliance and having a useful life of a few thousands hours, is described.—J. S. G. T.

A Catalyst Chamber. Samuel Yuster (*J. Physical Chem.*, 1932, **36**, 1056).—A simple form of catalyst chamber made of glass, easily assembled, and inserted in a train of apparatus is described.—J. S. G. T.

VII.—PHYSICAL AND MECHANICAL TESTING AND RADIOLOGY

(Continued from pp. 213–246.)

Report of Committee E–1 [of A.S.T.M.] on Methods of Testing. W. H. Fulweiler and R. E. Hess (*Proc. Amer. Soc. Test. Mat.*, 1931, **31**, (I), 588–594).—See this *J.*, 1931, **47**, 441.—S. G.

Proposed Methods of Rockwell Hardness Testing of Metallic Materials. —— (*Proc. Amer. Soc. Test. Mat.*, 1931, **31**, (I), 595–598).—Appendix I to Report of Committee E–1 on Methods of Testing (see preceding abstract). See this *J.*, 1931, **47**, 441.—S. G.

Testing Hardness of Metals by the Vickers Diamond Pyramid Machine. F. J. Pearson (*Commonwealth Eng.*, 1932, **19**, 208–211).—A full description of the construction and operation of the Vickers Diamond Pyramid machine for hardness testing is given, and it is shown that the hardness numbers obtained are constant irrespective of the load.—J. H. W.

A Dwarf Brinell Press. Anon. (*Met. Ind.* (*Lond.*), 1932, **40**, 220).—Short note describing a small Brinell hardness testing machine, using a 5-mm. ball and a load of 750 kg. for 30 seconds.—J. H. W.

Proposed Requirements for Speed of Tension Testing of Metallic Materials. —— (*Proc. Amer. Soc. Test. Mat.*, 1931, **31**, (I), 599–601).—Appendix II to Report of Committee E–1 on Methods of Testing (abstract above). See this *J.*, 1931, **47**, 442.—S. G.

Proposed Definitions of Terms Relating to Methods of Testing. —— (*Proc. Amer. Soc. Test. Mat.*, 1931, **31**, (I), 602–604).—Appendix III to Report of Committee E–1 on Methods of Testing (abstract above). See this *J.*, 1931, **47**, 441.—S. G.

Tentative Revisions of A.S.T.M. Standards. Standard Definitions of Terms Relating to Methods of Testing (E 6–30). —— (*Proc. Amer. Soc. Test. Mat.*, 1931, **31**, (I), 1070).—See this *J.*, 1930, **44**, 592.—S. G.

A Further Resumé of the Notched-Bar Impact Test in the Light of Present Knowledge. J. M. Lessells (*Proc. Amer. Soc. Test. Mat.*, 1931, **31**, (I), 605–

607).—Appendix IV to Report of Committee E-1 on Methods of Testing (abstract above). See this *J.*, 1931, **47**, 442.—S. G.

New Creep Testing Apparatus at the Massachusetts Institute of Technology. F. H. Norton and J. B. Romer (*Proc. Amer. Soc. Test. Mat.*, 1931, **31**, (I), 129–135).—Appendix III to Report of Joint Research Committee on Effect of Temperature on the Properties of Metals (see *J.*, this volume, p. 290). Illustrated.—S. G.

Apparatus for Low-Temperature Endurance Testing. H. W. Russell and W. A. Welcker, Jr. (*Proc. Amer. Soc. Test. Mat.*, 1931, **31**, (I), 122–128).—Appendix II to Report of Joint Research Committee on Effect of Temperature on the Properties of Metals (see *J.*, this volume, p. 290). See this *J.*, 1931, **47**, 441.—S. G.

Fatigue Tests of Weld Metal. R. E. Peterson and C. H. Jennings (*Proc. Amer. Soc. Test. Mat.*, 1931, **31**, (II), 194–200; discussion, 201–203).—See this *J.*, 1931, **47**, 391.—S. G.

Fatigue Testing of Wire. Stephen M. Shelton (*Proc. Amer. Soc. Test. Mat.*, 1931, **31**, (II), 204–213; discussion, 214–220).—See this *J.*, 1931, **47**, 391.
—S. G.

Tentative Method of Bend Testing for Ductility of Metals (E 16–31 T). —— (*Proc. Amer. Soc. Test. Mat.*, 1931, **31**, (I), 1034–1036).—S. G.

[Testing of] Castings. Anon. (*Metallurgist* (Suppt. to *Engineer*), 1932, **8**, 34–35).—Some comments on the discussion on the testing of castings held at the Spring Meeting, 1932, of the Institute of Metals.—R. G.

Pioneer Tests of Aluminium Beams. R. L. Templin and E. C. Hartmann (*Aluminium Broadcast*, 1930, **2**, (21), 9; (31), 9–10).—Abstracts from *Eng. News-Record*, 1930, **104**, 314–316. The results of tests on ten 10½ ft. I beams—6 of heat-treated Duralumin, and 4 of steel—are tabulated, and the actual strengths of the structures compared with those computed from test results on small samples cut from each beam. Loading was applied at the third-points of each 10-foot span length, using a 100,000-lb. testing machine. Failure in every case occurred by sideways buckling of the top flange.—J. C. C.

Tentative Method of Test for Determining the Temperature Resistance Constants of Resistance Alloys (B 84–31 T). —— (*Proc. Amer. Soc. Test. Mat.*, 1931, **31**, (I), 732–737).—See *J.*, this volume, pp. 91–92.—S. G.

Tentative Definitions of Terms, with Units and Symbols, Relating to Magnetic Testing (A 127–31 T). —— (*Proc. Amer. Soc. Test. Mat.*, 1931, **31**, (I), 696–699).—See this *J.*, 1931, **47**, 662.—S. G.

Tentative Specifications for Round-Hole Screens for Testing Purposes (E 17–31 T). —— (*Proc. Amer. Soc. Test. Mat.*, 1931, **31**, (I), 1032–1033).—See *J.*, this volume, p. 93.—S. G.

VIII.—PYROMETRY

(Continued from p. 246.)

Pocket Radiation-Pyrometer. Anon. (*Amer. Machinist* (*Eur. Edn.*), 1932, **75**, 277E).—A short description of the Keiser and Schmidt pocket radiation-pyrometer is given. This instrument is entirely self-contained and has a range of 600°–2400° C. with a guaranteed accuracy of ± 15° C. at 1500° C.
—J. H. W.

The Tungsten–Molybdenum Thermocouple. D. Binnie (*Met. Ind.* (*Lond.*), 1932, **40**, 299).—Abstract of a paper read before the North-Western Section of the Institute of Fuel. See *J.*, this volume, p. 175.—J. H. W.

IX.—ELECTROMETALLURGY AND ELECTROCHEMISTRY

(Continued from pp. 246–252.)

ELECTRODEPOSITION

Glacial Acetic Acid as a Solvent for the Electrodeposition of Metals. An X-Ray Diffraction Study of the Structure of Deposits of Arsenic, Antimony, and Bismuth. C. W. Stillwell and L. F. Audrieth (*J. Amer. Chem. Soc.*, 1932, **54**, 472–478).—The elements were deposited from a glacial acetic acid solution of their chlorides. The deposits of arsenic were always amorphous, and those of bismuth crystalline. Antimony may be deposited in the explosive metastable modification or in the crystalline form, depending on conditions of temperature and concentration. Bismuth might be expected to deposit in the non-crystalline form from solvents permitting the maintenance of a much lower temperature.—R. G.

Cadmium Plating vs. Corrosion Fatigue. Pickling vs. Corrosion Fatigue. Wilber E. Harvey (*Metals and Alloys*, 1932, **3**, 69–72).—Cadmium or zinc platings on steel act as good protection against corrosion fatigue. Previous pickling of the steel, however, reduces the resistance to corrosion fatigue owing to the embrittlement caused by adsorption of hydrogen. Degreasing the iron surface with organic solvents is satisfactory if the metal is to be plated with zinc, but cadmium does not adhere well to surfaces cleaned in this way. —A. R. P.

The Stability of Cadmium Plating Solutions. S. Wernick (*Metal Cleaning and Finishing*, 1931, **3**, 755–760; *C. Abs.*, 1932, **26**, 34).—See this *J.*, 1931, **47**, 547.—S. G.

Cadmium Deposits on Iron and Steel Castings. E. T. Richards (*Met. Ind.* (*Lond.*), 1932, **40**, 357–358).—Abstract from *Giesserei*, 1931, **18**, 516; see *J.*, this volume, p. 176.—J. H. W.

Coefficient of Metal Distribution in Chromium Plating. R. J. Piersol (*Metal Cleaning and Finishing*, 1931, **3**, 587–590, 647–650; *C. Abs.*, 1932, **26**, 34).—A discussion of the coeff. of chromium distribution in the plating bath and its determination.—S. G.

Bright Plating Ratio in Chromium. R. J. Piersol (*Metal Cleaning and Finishing*, 1931, **3**, 751–754; *C. Abs.*, 1932, **26**, 34).—A procedure is recommended for the determination of the optimum chromium plating conditions. —S. G.

Problems in High Current Density Nickel and Chromium Deposition. N. R. Laban (*J. Electroplaters' Depositors' Tech. Soc.*, 1931, **6**, 159–166).—Cf. this *J.*, 1931, **47**, 39. A discussion of the special procedure involved in electroplating nickel and chromium on mass-production lines at high current density. In order to obtain perfect adhesion and freedom from porosity, growths, and brittleness, it is essential to etch the surface of the base metal prior to nickel deposition. Electrolytic etching is favoured, and the process is applicable to all steels, nickel, copper, nickel–copper alloys, certain brasses, and nickel–silver. The special difficulties peculiar to nickel deposition at *high* current density are (1) inclusion of foreign matter in the deposit due to vigorous agitation, (2) low " throwing power " of the solution, and (3) variations in thickness of deposits due to various causes. These are treated in detail. The nickel deposits prior to chromium plating require to be mopped to a greater depth than usual over an etched base, the minimum thickness of nickel being 0·0005 in. Control of chromium-plating solutions is stated to present no difficulty if antimonial lead is used for anodes and vat linings. High density solutions containing 400 grm./litre chromic acid are most suited to mass-production work, and a plate of 10–15 minutes at 80–100 amp./ft.^{2} gives satisfactory results.—S. W.

American and Continental Practice in Nickel Deposition. W. T. Griffiths (*J. Electroplaters' Depositors' Tech. Soc.*, 1931, **7**, 51–70; and *Met. Ind.* (*Lond.*), 1931, **39**, 443–446, 493–496, 543–546; discussion, 546–593; also *Nickel Bulletin,* 1931, **4**, 349–360; (abstract) *Brass World*, 1931, **27**, 251–254; (summary) *Metallurgist* (Suppt. to *Engineer*), 1932, **8**, 13–15).—A detailed description of the most modern phases of nickel-plating practice abroad, excellently illustrated by photographs of American and Continental plating plants. Commercial electroplating procedure in the U.S.A. is summarized and the methods used in preparing steel, brass, zinc, or aluminium are outlined. The tendency in chromium-plating practice is to specify a minimum thickness of copper + nickel on steel of 0·001 in. followed by at least 0·000025 in. of chromium. The compositions and operating conditions obtaining in U.S. nickel-plating solutions are tabulated in detail, indicating considerable variation in practice. The direction of development on the Continent tends towards (1) introduction of semi- and full-automatic plants, and (2) organization of operations and high current density, so that while output is maintained, the size of plant is reduced and labour diminished. The procedure at the following typical Continental plants is described in some detail: Automobiles Chenard et Walcker (France); Etablissements Continsouza (France); Atelier, J. M. (France); Société de Radiateurs Chausson (France); Automobiles Rénault (France); Automobiles Citröen (France); Opel-Werke, A.G. (Germany); Siemens-Schuckert and Göricke Werke (Germany).—S. W.

" Stopping Off " Materials for Use in the Electrodeposition of Nickel. D. J. Macnaughtan and A. W. Hothersall (*J. Electroplaters' Depositors' Tech. Soc.*, 1930, **6**, 29–40; and *Trans. Faraday Soc.*, 1930, **26**, 163–172; also (abstract) *Met. Ind.* (*Lond.*), 1931, **38**, 121–122; discussion, 148–149).—" Stopping off " materials (used to prevent deposition on portions of a cathode for either decorative or protective purposes) must possess the following properties: (1) ease of application; (2) toughness and flexibility to withstand handling without cracking or flaking; (3) good adhesion and capacity to resist without detachment the pressure exerted by gas bubbles forming underneath its surface, at edges, pin-holes, and other discontinuities in cleaning solutions; (4) must not soften unduly at the working temperature of the solution, and (5) chemical inertness to nickel-plating solutions. Oil varnishes, and those of india-rubber, gutta-percha, ebonite, bitumen, and shellac produced unsatisfactory coatings. " Necol " (cellulose ester type) varnish formed a satisfactory insulating coating; mixtures of paraffin-wax with " Chatterton Compound " or bitumen were also satisfactory, but tend to contaminate the nickel solution, producing brittle, exfoliated deposits containing a high percentage of carbon. The contaminant may be removed by " working out " in time, or, rapidly, by oxidation of the organic constituents by boiling with permanganate of potash. —S. W.

Chemical Control of Nickel-Plating Baths. L. C. Pan (*Metal Cleaning and Finishing*, 1931, **3**, 703–708, 732; *C. Abs.*, 1932, **26**, 34).—A detailed description of the composition of single and double salt nickel-plating baths. The volumetric determination of nickel is described. An analysis chart is given from which Ni, $NiSO_4{\cdot}7H_2O$, $Ni(NH_4SO_4)_2{\cdot}6H_2O$, and $NiCl_2{\cdot}6H_2O$ can be directly read off in oz. per gall. from the number of c.c. standard NaCN solution used.—S. G.

Recent Developments in Nickel Plating. M. de Kay Thompson (*Metal Cleaning and Finishing*, 1931, **3**, 625–628, 717–719; *C. Abs.*, 1932, **26**, 34).—A historical review of early nickel-plating developments dating from 1834. The composition of solutions, impurities in the bath, anodes, nickel deposit, cathode current efficiency, current density, conductivity of nickel solution, and throwing power are discussed.—S. G.

White Spots on Silver-Plated Ware. Anon. (*Met. Ind.* (*Lond.*), 1932, **40**, 286).—According to Moser, Fröhlich, and Raub (*Z. angew. Chem.*, 1931, **44**, 97–100; this *J.*, 1931, **47**, 445), white spots occurring on silver-plated ware start from nuclei, which are small hollows in the plated ware, filled with the solution used for plating. At the base of these hollows, there is normally a speck of cuprous oxide on which the silver at first will not deposit. Later, the silver grows over the inclusion and imprisons some of the solution which, in the burnishing process, oozes out and causes the characteristic efflorescence. This investigation points to the need of annealing base metals under conditions which will keep oxidation at a minimum and of absolute cleanliness.

—J. H. W.

The Rise and Early Development of Electrodeposition. R. S. Hutton (*J. Electroplaters' Depositors' Tech. Soc.*, 1931, **7**, 78–82).—Address delivered before the Electroplaters' and Depositors' Technical Society at the Royal Albert Hall on the occasion of the Faraday Centenary Celebrations. An historical survey of the progress of electrodeposition (including the development of the dynamo and electro-refining progress) from the time of Davy and Faraday to the present day. Attention is directed to the vast scale of the electrolytic winning and refining of metals to-day as shown in the following very interesting table:—

ELECTROLYTIC WORLD PRODUCTION OF METALS.
(Approximate Annual Total (Tons) in 1929 or 1930.)

	Tons per annum.	Total Electrical Energy used (approx.). (Millions kw.hrs.)
Aluminium	267,000	8,000
Zinc	390,000	1,800
Copper refined . . .	1,500,000	485
Copper from leached ores .	200,000	400
Lead	220,000	30
Sodium	20,000	325
Nickel	24,500	60
Cadmium	1,250	3
Magnesium	2,500	50
Silver	6,500	6
Tin	2,000	...
Total . .	...	11,159

The total electric energy utilized in the world for metal production *by electrolysis alone* is as great as that generated by all authorized undertakings in the U.K. for domestic and public service purposes. Figures for the world's production of metals are added, comparing the present output with that of a century ago:—

	1831. Tons.	1929. Tons.
Copper	28,000	1,920,000
Lead	90,000	1,750,000
Zinc	9,000	1,400,000
Tin	7,300	190,000
Aluminium	Nil	267,000

—S. W.

The Structure of Electrodeposited Metals. Leslie B. Hunt (*Met. Ind.* (*Lond.*), 1931, **39**, 349–351, 447–448; 1932, **40**, 40–42, 133–134, 283–285).—The various kinds of electrodeposition included in the terms "electroforming" and "electroplating" are discussed, and the principles underlying the latter process are considered under the following heads: Migration and hydration of ions; the degree of dissociation of electrolytes and Ostwald's dilution law; Debye and Hückel's equation for the conductivity of dilute solutions; modifications of Onsager's theory; the structure of electrodeposits; static or equilibrium potentials; polarization; the Blum–Rawdon theory; the effect of current density and of temperature; the tensile strength of electrodeposited copper; methods of increasing conductivity; metal-ion and hydrogen-ion concentrations; complex electrolytes; secondary ionization; the behaviour of cobalt salts; the use of glycocoll. Many references are given.—J. H. W.

A Study of the Structure of Electrodeposited Metals. L. B. Hunt (*J. Physical Chem.*, 1932, **36**, 1006–1020).—Factors influencing the structure of electrodeposited metals—nucleus formation, crystal growth and orientation, cathode polarization, &c.—are critically reviewed, and a hypothesis based on the relation of the concentration of metal in the cathode film to the concentration of other constituents of that film is advanced to explain the observed phenomena.—J. S. G. T.

Metal Plating without External Current. Artur Kutzelnigg (*Z. Elektrochem.*, 1932, **38**, 154–158).—Theoretical considerations of plating by dipping are discussed, and the composition of various solutions by which plating with gold, silver, copper, and tin can be effected are given.—J. H. W.

Moulding in Metal. J. Homer Winkler (*Brass World*, 1932, **28**, 7).—Abstract from the *Electrotypers' Bulletin*, **1931**, December. Describes lead moulding, electrodeposition, moulding with fusible alloy melting at about 70° C., and the Galvanotex process, which consists of extruding a thin sheet of aluminium, zinc, chromium, lead, or other metal by moulding.—J. H. W.

A New Method for the Hydrogen-Ion Control of Electroplating Solutions. I. Laird Newell (*Brass World*, 1932, **28**, 1–2).—A description of a hydrogen-ion slide titrator is given. The apparatus is extremely simple to use and can be employed, not only in adjusting electroplating and electrotyping baths, but in practically every process where p_H control is required.—J. H. W.

ELECTRO-REFINING, &c.

Electrochemistry and Electrometallurgy. Annual Report of Committee on Electrochemistry and Electrometallurgy. —— (*J. Amer. Inst. Elect. Eng.*, 1931, **50**, 570–574).—The report covers the period 1928 and 1930 and outlines the most important developments during that period. Copper, sodium, zinc, aluminium, barium, beryllium, and magnesium are mentioned. Under the heading of metal powders it is stated that electrolytic means have been developed for producing copper, tin, nickel, silver, and lead in crystalline form in sizes as fine as 500 mesh. The electrodeposition of tungsten from a wet alkaline bath is also reported, and since this metal has a marked resistance to acid attack and wear, this development may prove of considerable industrial importance.—S. V. W.

Electrolysis in Technical and Economic Competition with Other Processes of Metal Recovery and Refining. H. Wohlwill (*Metall u. Erz*, 1932, **29**, 1–9). —Electrolytic and smelting processes for the recovery and refining of copper, zinc, lead, and nickel are described and their relative merits discussed.
—A. R. P.

The Application of Chiolite to the Electrolysis of Alumina. I.—The Fusion Temperature of the System Alumina–Cryolite–Chiolite. L. Wasilewski and S. Mantel (*Aluminium Broadcast*, 1930, **2**, (19)).—Translated from *Przemysl Chemiczny*, 1930, **14**, 25–31. The fusion temperatures of the systems alumina–

chiolite, chiolite–cryolite, and alumina–chiolite–cryolite were determined. From the results obtained, and from laboratory tests with a 400-amp. electrolyzer, it appears that chiolite is a better flux than fluorspar, since by its use the temperature can be decreased by about 50° C. Using 10% to 16% alumina, electrolysis is possible below 850° C. if the ratio of chiolite to cryolite is 32 : 68; and is possible below 900° C. with chiolite–cryolite ratios between 20 : 80 and 35 : 65.—J. C. C.

Electrolytic Extraction of Magnesium from Carnallite. I. G. Shcherbakov, S. V. Karpachev, and O. I. Poltoratzkaya (*J. Chem. Ind.* (*Russia*), 1930, 7, (31/33), 1900–1904; *C. Abs.*, 1932, **26**, 33).—[In Russian.] Experiments were conducted to find conditions under which magnesium deposited from a bath of molten salts will become contaminated with alkali impurities. The bath consisted of magnesium chloride, potassium chloride, and sodium chloride, the last two in the ratio 1·5 : 1·0. Even when magnesium chloride in the bath reaches a low value ($<$0·5%), sodium does not enter magnesium metal, whilst magnesium contains an appreciable amount of potassium when magnesium chloride decreases to 20%. At an average cathode density of 20–40 amp./cm.^{2}, the magnesium chloride content can be lowered from 53% to 12% without introducing more than 0·1% of potassium into the magnesium deposit. Addition of sodium chloride is important, because it reduces the melting point of the bath and at the same time dilutes the potassium chloride content, which is helpful in keeping potassium out of magnesium. Details of operation of a laboratory-size electrolytic bath are given.—S. G.

Electrolytic Refining of Tin. Zenhichi Kimura (*J. Min. Inst. Japan*, 1931, **47**, 966–1001; *Power Bibliography*, 1931, (12), 7).—[In Japanese.] Deals with the method of electrolytic refining successfully applied to the crude tin from the Ikuno Mine. The crude tin contains considerable amounts of impurities, and its composition is : tin 90–96, copper 2–5, lead 0·3–0·7, bismuth 0·3–0·6, iron 0·07–0·21, arsenic 0·4–0·6, antimony 0·5–0·6%. In order to find the most suitable, K. investigated various electrolytes consisting primarily of stannous chloride or stannous sulphate, with various amounts of hydrochloric acid, sulphuric acid, sodium sulphate, sodium chloride, ammonium chloride, aluminium sulphate, hydrofluosilicic acid, hydrofluoric acid, sodium fluoride, cresol sulphonic acid, toluol sulphonic acid, &c., and with some addition agents. He concluded that for crude tin containing much copper, the sulphuric acid electrolyte, modified by the addition of a small percentage of hydrofluosilicic acid in order to prevent the hydrolysis of the tin salt, gives the best result, while tin containing lead as chief impurity does not require the use of hydrofluosilicic acid. K. recommends an electrolyte of the following composition for the crude metal : SiF_6 5·50, H_2SO_4 6, $Sn^{\cdot\cdot}$ 3, glue 0·1, betanaphthol 0·01, and a minute amount of HF. The treatment of the slime containing a considerable amount of copper, lead, and bismuth is also described. Most of the tin and bismuth is dissolved in concentrated hot sulphuric acid, leaving copper insoluble. The bismuth is recovered by cementation and the solution is electrolyzed with an insoluble anode to recover tin.
—S. G.

ELECTROCHEMISTRY—GENERAL

The Stick Antimony Electrode : Preparation and Calibration. L. R. Parks and H. C. Beard (*J. Amer. Chem. Soc.*, 1932, **54**, 856–864).—The stick antimony electrode is used in electrometric titrations. An electrode potential, indicative of the p_H of the solution, is set up by the metal in equilibrium with its oxide. Cast electrodes were used in the experimental work, and cleaned sticks, atmospherically oxidized, were more satisfactory than when attempts were made to increase the oxide film. With the use of a vacuum-tube potentiometer the stick antimony electrode gives rapid, constant, and reproducible readings.
—R. G.

X.—INDUSTRIAL USES AND APPLICATIONS

(Continued from pp. 253–256.)

Aluminium Foil. Anon. (*Aluminium Broadcast*, 1930, **2**, (24)).—Aluminium foil is compared with lead and tin foil and its uses are reviewed.—J. C. C.

[Aluminium Foil Tape.] On the Durability of Rubber-Insulated Wires. T. Yamasaki (*Electrical Engineering* (*Japan*), 1931, (220), 294–298; *Power Bibliography*, **1931**, (6), 6).—[In Japanese.] In order to improve the durability of rubber-insulated wires, it is necessary to protect the layer of rubber insulation from oxidation by air and at the same time from its coming into contact with the moisture-proof compound with which the braid is impregnated. In some rubber-insulated wires, rubber-coated cotton tape is inserted between the two layers of rubber and braid, but Y. considers the tape unsuitable for the purpose. He has introduced a thin, flexible, dense, and liquid-proof material such as ceresin or aluminium foil tape to take the place of the rubber-coated cotton tape. Durability tests on the new wires gave very excellent results as compared with the ordinary rubber-insulated wires.—S. G.

The Alfol System of Heat Insulation: Aluminium as an Insulating Material. Anon. (*Met. Ind.* (*Lond.*), 1932, **40**, 205).—Cf. this *J.*, 1931, **47**, 167, 554. Circular issued by the Intelligence Department of the British Aluminium Co., Ltd. Describes the use of aluminium foil as a heat-insulating material. Originally, concentric layers of foil were laid over metal separators, thus being applicable only to straight pipes or bodies of regular shape. These separators are now dispensed with and crumpled foil is used, providing completely efficacious insulation.—J. H. W.

The Influence of Paint on the Efficiency of Heating Bodies. Max Werner (*Hauszeit. V.A.W. u.d. Erftwerk A.G. Aluminium*, 1930, **1**, 301–303).—Comparative investigations of the radiation capacity of various paints at 100° C. have revealed the following: the radiation coeff. of mineral colours (including black, red, yellow, brown, green, and even white) is practically independent of the colour tone, *i.e.* 92–96% of that of the black body. The radiation coeff. of aluminium paint, aluminium sheet, aluminium sheet coated with linseed oil, iron sheet, and burnished brass are 62%, about 8·7%, 56%, 74%, and 43%, respectively.—M. H.

Applications of Aluminium Wire Mesh. Anon. (*Aluminium Broadcast*, 1930, **2**, (17)).—A brief list of uses.—J. C. C.

The Use of Aluminium in the American Automobile Industry in 1929. Anon. (*Aluminium Broadcast*, 1930, **2**, (18)).—Statistical.—J. C. C.

All-Metal Bodywork [Aluminium]. Anon. (*Aluminium Broadcast*, 1930, **2**, (23), 27–28).—Examples of the use of aluminium alloys in omnibus construction.—J. C. C.

Aluminium Oil and Petrol Motor Transport Tanks. Anon. (*Aluminium Broadcast*, 1930, **2**, (18)).—Brief notes on the method of constructing welded aluminium transport tanks and their advantages over steel tanks.—J. C. C.

Aluminium Street Car. Anon. (*Aluminium Broadcast*, 1930, **2**, (18)).—Details of the aluminium body of a street car built by the Pittsburgh Railways Co.—J. C. C.

Aluminium and Aluminium Alloys in Railway Rolling Stock. Anon. (*Aluminium Broadcast*, 1930, **2**, (26), 25–30).—A general review of the advantages of aluminium and its alloys in railway coach construction, accompanied by examples from American and German practice.—J. C. C.

Light Alloys in Rail Transport. Anon. (*Aluminium Broadcast*, 1930, **2**, (17)).—Translation of a booklet issued by Aluminium Ltd., Geneva, describing, by examples from American, English, and Italian practice, the use made of aluminium alloys in train and tram construction.—J. C. C.

[Aluminium] Weft Bobbins. Anon. (*Aluminium Broadcast*, 1930, **2**, (27), 25).—Summarizes claims made for aluminium pirns for textile purposes.—J. C. C.

Aluminium in the Canning and Allied Industries. A. G. Thornton (*Aluminium Broadcast*, 1930, 2, (18)).—A special low-melting point solder appears to give promising results for sealing the air-hole in aluminium cans after the food is cooked.—J. C. C.

Aluminium in Oil Production. Anon. (*Aluminium Broadcast*, 1930, 2, (22), 30–31).—The advantages of using aluminium for vessels and apparatus in the oil industry are put forward.—J. C. C.

Aluminium in Architecture and Building Construction. Anon. (*Aluminium Broadcast*, 1930, 2, (30), 21–27).—A review of the advantages and possibilities of using aluminium for decorative and structural purposes, with particulars of some notable applications to public buildings.—J. C. C.

Aluminium in the Furnishing Trade. Anon. (*Aluminium Broadcast*, 1930, 2, (24)).—Notes on the advantages and construction of aluminium furniture. —J. C. C.

Screw Machine Products of Aluminium. Anon. (*Aluminium Broadcast*, 1930, 2, (18)).—Review of a booklet issued by the Aluminum Company of America.—J. C. C.

The Use of Aluminium for Switchgear. H. Schmitt (*Aluminium Broadcast*, 1930, 2, (24)).—Abstracted from *Hauszeit. V.A.W. u.d. Erftwerk A.G. Aluminium*, 1930, 2, 3–18. See this *J.*, 1931, 47, 202.—J. C. C.

Lake Coleridge Plain Aluminium Transmission Line. Anon. (*Aluminium Broadcast*, 1930, 2, (17)).—The causes of the unsatisfactory operation and corrosion of the main aluminium conductors of this line, erected in 1913, are ascribed largely to bad erection practices. The electrical resistance of samples removed in 1928 was slightly more than 5% above the present British Engineering Standards Association standards. The original resistance is unknown, but was probably high. The increase, if any, was thus very small. —J. C. C.

Comparison of the Materials for Overhead Transmission Cables According to the Present Position of Research. —— Schmitt (*Hauszeit V.A.W. u.d.. Erftwerk Aluminium A.G.*, 1929, 1, 3–12).—A comprehensive discussion of the suitability of copper, aluminium, steel–aluminium, and Aldrey as materials for overhead lines with respect to mechanical properties (especially endurance strength), physical properties, security at low temperatures, behaviour under vibration, resistance to atmospheric corrosion, and economic questions. In each respect Aldrey proves to be at least as suitable as copper and steel–aluminium and superior to these materials in regard to mechanical properties and price.—M. H.

Aluminium Alloy Pistons for Diesel Motors. G. Mortimer and J. F. Paige (*Rev. Aluminium*, 1932, 9, 1621–1637).—The advantages and disadvantages of the various aluminium alloys used for pistons for Diesel motors are given, and the construction of these pistons is described. Criteria for choosing the alloys are set out, and the moulds used and the melting and casting of the alloys are described. Great care is required to ensure that the alloys receive the proper heat-treatment, which is outlined here for typical suitable alloys. —J. H. W.

Duralumin Connecting Rods. Anon. (*Aluminium Broadcast*, 1930, 2, (26), 20).—Various methods of constructing the bearings of Duralumin connecting rods are outlined.—J. C. C.

Construction Combining Steel and Aluminium. C. Rougeron (*Aluminium Broadcast*, 1930, 2, (23), 19–26).—Translation of an article in *Bulletin technique du Bureau Veritas*, 1929, 11, 225–227. The use of composite structures of steel and Duralumin for ship construction is considered in detail, on the basis of making use of the low coeff. of elasticity of Duralumin. In a composite framework, the Duralumin will be stressed only a third as much as the steel for the same deflection.—J. C. C.

Report of Committee B–7 [of A.S.T.M.] on Light Metals and Alloys, Cast and Wrought. J. B. Johnson and J. A. Gann (*Proc. Amer. Soc. Test. Mat.*, 1931, **31**, (I), 284–288).—See this *J.*, 1931, **47**, 552.—S. G.

Proposed Revisions in Tentative Standards for Light Metals and Alloys, Cast and Wrought. —— (*Proc. Amer. Soc. Test. Mat.*, 1931, **31**, (I), 289–294). —Appendix to Report of Committee B–7 of A.S.T.M. on Light Metals and Alloys, Cast and Wrought (preceding abstract). See this *J.*, 1931, **47**, 553.—S. G.

Tentative Specifications for Aluminium-Base Alloy Die-Castings (B 85–31 T). —— (*Proc. Amer. Soc. Test. Mat.*, 1931, **31**, (I), 716–718).—See *J.*, this volume, pp. 103–104.—S. G.

A New Era in Boat Construction. Anon. (*English Mechanics*, 1932, **11**, 373–374).—The discovery of the light alloy Birmabright has enabled boats to be constructed with the frame and plates of the new alloy, which is stated to be resistant to corrosion by sea-water. This property is derived from the ability of the alloy to form a thin protective surface film.—W. P. R.

Report of Committee B–5 [of A.S.T.M.] on Copper and Copper Alloys, Cast and Wrought. C. H. Mathewson and D. K. Crampton (*Proc. Amer. Soc. Test. Mat.*, 1931, **31**, (I), 258–260).—See this *J.*, 1931, **47**, 557.—S. G.

Copper Pipes for Water Conduction. —— Schacht (*Pumpen-Brunnenbau*, **1930**, 337–339; *Wasser u. Abwasser*, **27**, 203; *C. Abs.*, 1932, **26**, 542).—Though the cost of copper piping is higher, its increased wear and freedom from corrosion make its use more economical in the long run than iron piping. On hygienic grounds there is nothing against the use of copper for water pipes. —S. G.

Tentative Specifications for Copper-Base Alloys in Ingot Form for Sand-Castings (B 30–31 T). —— (*Proc. Amer. Soc. Test. Mat.*, 1931, **31**, (I), 703–707).—See this *J.*, 1930, **44**, 644–645.—S. G.

Tentative Revisions of A.S.T.M. Standards. Standard Specifications for Bronze Bearing Metal in Ingot Form (B 31–21). —— (*Proc. Amer. Soc. Test. Mat.*, 1931, **31**, (I), 1050–1051).—See this *J.*, 1928, **40**, 648–649.—S. G.

Antimony, Iron, and Arsenic in Bearing Bronzes. Gerhard Wolf (*Metallurgist* (Suppt. to *Engineer*), 1932, **8**, 43–44).—The effects of antimony, iron, arsenic, and phosphorus in bearing bronze are considered in relation to the general composition of the alloy. The effect of high lead content is to raise the limit beyond which increase of antimony content leads to brittleness. Reference is made to recent work by Ameline (France) on the effect of arsenic. The opinion is expressed that whenever a high degree of elasticity and strength is desired, antimony should be added rather than arsenic. Few experiments have been made on the effect of manganese. A table is given showing the composition of 13 bearing bronzes.—R. G.

Everdur Metal—A High Strength Corrosion-Resistant Engineering Material. C. B. Jacobs, Jr. (*Metals and Alloys*, 1932, **3**, 26).—A brief account of the uses to which the alloy Everdur is now put. Sand-castings contain copper 94·3, silicon 4·5, and manganese 1·2% and the wrought alloy copper 96, silicon 3, and manganese 1%.—A. R. P.

Tentative Revisions of A.S.T.M. Standards. Standard Specifications for Seamless Admiralty Condenser Tubes and Ferrule Stock (B 44–29). —— (*Proc. Amer. Soc. Test. Mat.*, 1931, **31**, (I), 1051).—See this *J.*, 1930, **44**, 647.—S. G.

Tentative Revisions of A.S.T.M. Standards. Standard Specifications for Seamless 70 : 30 Brass Condenser Tubes and Ferrule Stock (B 55–25). —— (*Proc. Amer. Soc. Test. Mat.*, 1931, **31**, (I), 1051).—See this *J.*, 1930, **44**, 647. —S. G.

Tentative Revisions of A.S.T.M. Standards. Standard Specifications for Seamless Muntz Metal Condenser Tubes and Ferrule Stock (B 56–25). —— (*Proc. Amer. Soc. Test. Mat.*, 1931, **31**, (I), 1051).—See this *J.*, 1930, **44**, 647. —S. G.

Lead Sheaths for Cables. N. A. Allen (*Elect. Rev.*, 1931, **108**, 275–276, 321–322; *Power Fuel Bull.*, 1931, (2), 34).—Cables with pure lead sheaths eventually fail, if subjected to severe tensile stress during installation or operation; repeated movement; frequent or cyclic variation of temperature; intermittent or continuous chemical attack; electrolysis; mechanical vibration during transport to site or after installation; direct mechanical abrasion; damage by animals or insects; or a combination of two or more of the above factors. Examples of the above cases are given, together with a list of characteristics which must be aimed at in designing an improved sheathing for cables.—S. G.

Progress in Power Cable Technique. P. Dunsheath (*Contact*, 1931, **11**, 107; *Power Fuel Bull.*, 1931, (2), 34).—An illustrated review of modern theory and practice of the structure of high- and low-voltage cables. Detailed descriptions and data are given in respect of the following allied subjects: the formation of shaped conductor cables; improvements in lead sheathing; the introduction of an entirely new type of lead press which applies the sheath to the cable without a weld; lead sheath corrosion; the value of oil-filled cable for cables of 66 kv.; physical properties of the dielectric; sheath and armour effects; quality assessment. Three different tests are at present competing for honours of providing a true indication of the quality of a super-tension cable, and the order of its reliability in service; these are: (1) breakdown test; (2) ionization test; (3) stability test.—S. G.

On Cable Failures on the Underground Lines of the Tokyo Municipal Railway. S. Kumano (*Electrical Engineering*, 1931, (217), 142–144; *Bull. Pubns. Power Fuel*, 1931, April, 7).—[In Japanese.] The Tokyo Municipality has an extensive underground cable system in the metropolitan district to distribute electrical energy to the various sections of its railway. There are 5 different voltages in use, ranging from 600 to 22,000 v. Underground telephone cable is also reported on. The total length of cable is 375,510 m. Detailed tables have been compiled of the cable and joint failures over the period 1923–1930. The causes leading to the failures are analyzed. Of a total number of 344 cable failures, 322 occurred in the direct laying systems, of which 62% are attributed to external causes effecting mechanical injury to the lead sheath. There were 245 joint failures, of which 59% were due to excessive tension on the joints.—S. G.

Tentative Specifications for Insulated Wire and Cable: 30 Per Cent. Hevea Rubber (D 27–31 T). —— (*Proc. Amer. Soc. Test. Mat.*, 1931, **31**, (I) 926–943).—See *J.*, this volume, p. 105.—S. G.

Tentative Specifications for Magnesium-Base Alloy Castings (B 80–31 T). —— (*Proc. Amer. Soc. Test. Mat.*, 1931, **31**, (I), 700–702).—See *J.*, this volume, pp. 106–107.—S. G.

Tentative Specifications for Ferro-Molybdenum (A 132–31 T). —— (*Proc. Amer. Soc. Test. Mat.*, 1931, **31**, (I), 694–695).—See this *J.*, 1931, **47**, 671. —S. G.

Tentative Specifications for Drawn or Rolled Alloy, 80 Per Cent. Nickel, 20 Per Cent. Chromium, for Electrical Heating Elements (B 82–31 T). —— (*Proc. Amer. Soc. Test. Mat.*, 1931, **31**, (I), 708–711).—See *J.*, this volume, p. 107.—S. G.

Tentative Specifications for Drawn or Rolled Alloy, 60 Per Cent. Nickel, 15 Per Cent. Chromium and Balance Iron, for Electrical Heating Elements (B 83–31 T). —— (*Proc. Amer. Soc. Test. Mat.*, 1931, **31**, (I), 712–715).—See *J.*, this volume, pp. 107–108.—S. G.

The Use of Zinc and Zinc Alloys in the Automotive Industry. Robert M. Curts (*Z. Metallkunde*, 1932, **24**, 45–46).—Abstracted from *J. Soc. Automotive Eng.*, 1931, **28**, 447–463; cf. this *J.*, 1931, **47**, 560.—M. H.

Tentative Specifications for Zinc-Base Alloy Die-Castings (B 86–31 T). —— (*Proc. Amer. Soc. Test. Mat.*, 1931, **31**, (I), 719–721).—See *J.*, this volume, pp. 108–109.—S. G.

Boilers and Metals. W. G. Case and W. E. Dennison (*Domestic Eng.*, 1931, **54**, 47–49, 54, 69–76; *Power Fuel Bull.*, 1931, (4), 66).—This paper is intended to throw some light on the relationship existing between boilers and the metals, or, more generally, the alloys of which they are made. The characteristics which a metal must possess in order that it may be suitable for the purpose are dealt with under the headings: (1) physical properties; strength and resistance to shock; (2) durability; resistance to corrosion; (3) facility with which the metal can be cast, welded, or riveted; (4) cost. The metals considered are cast iron, wrought iron, steel, copper, and aluminium. The types of corrosion and how they are caused are given as: external or fireside corrosion, and internal or water-side corrosion. Other matters dealt with are: relation of transmission of heat and conductivity; scale and incrustation and their causes. A final section concerns facility of design.—S. G.

Materials for Chemical Plant and Equipment. Alan A. Pollitt (*Dyer*, 1931, **66**, 529–533, 578–579; *C. Abs.*, 1932, **26**, 627).—The properties and use of ferrous and non-ferrous metals and of siliceous and organic substances are discussed.—S. G.

Report of Committee B–4 [of A.S.T.M.] on Electrical-Heating, Electrical-Resistance and Electric-Furnace Alloys. Dean Harvey and F. E. Bash (*Proc. Amer. Soc. Test. Mat.*, 1931, **31**, (I), 254–257).—See this *J.*, 1931, **47**, 559.
—S. G.

Report of Committee B–6 [of A.S.T.M.] on Die-Cast Metals and Alloys. H. A. Anderson and P. V. Faragher (*Proc. Amer. Soc. Test. Mat.*, 1931, **31**, (I), 261–264; discussion, 265–267).—See this *J.*, 1931, **47**, 561.—S. G.

Effect of Composition on Aluminium-Base Die-Casting Alloys. D. L. Colwell (*Proc. Amer. Soc. Test. Mat.*, 1931, **31**, (I), 268–277; discussion, 278–279).—Appendix I to Report of Committee B–6 on Die-Cast Metals and Alloys (see preceding abstract). See this *J.*, 1931, **47**, 428.—S. G.

Lead-Base and Tin-Base Alloys for Die-Castings. Fred J. Tobias (*Proc. Amer. Soc. Test. Mat.*, 1931, **31**, (I), 280–283).—Appendix II to Report of Committee B–6 on Die-Cast Metals and Alloys (see abstract above). See this *J.*, 1931, **47**, 561.—S. G.

The Possibilities of Metal Furniture. The Position of Design in Metal Manufacture. W. G. Raffe (*Met. Ind.* (*Lond.*), 1932, **40**, 321–322).—Necessary considerations in the design of all-metal furniture are discussed.—J. H. W.

Coating Concrete with Metal. Anon. (*Compressed Air Mag.*, 1930, **35**, (3), 3102).—Abridged from *Stove Trades Journal*. The Schoop metal-spraying process has been successfully applied to concrete and brickwork. The use of lead is recommended on account of its toughness and resistance to weathering, and the testing of such coated material in weirs, &c., is described.
—P. M. C. R.

XI.—HEAT-TREATMENT

(Continued from p. 256.)

Hardening of Non-Ferrous Alloys. Paul D. Merica (*Met. Ind.* (*Lond.*), 1932, **40**, 354).—Short abstract, from *Amer. Metal Market*, of a lecture to the Institute of Metals Division of the American Institute of Mining and Metallurgical Engineers.—J. H. W.

On the Variation of the Dimensions Produced by Annealing Cold-Worked Copper. A. Schweitzer (*Compt. rend.*, 1932, **194**, 449–450).—Specimens of copper, 8 mm. diameter and 3 mm. high, were cut from rods obtained by drawing from very homogeneous castings, and not differing between themselves in the degree of cold-working, as measured by the formula: cold-working $= \frac{S - s}{s} \times 100$, where $S =$ section after the final annealing and $s =$ the final section after cold-working. After machining, the specimens were annealed between 300° and 800° C. for 50 minutes in an electric furnace, fitted with a special water seal and filled with nitrogen to prevent oxidation. The specimens were very carefully measured before and after annealing, and from the results it was concluded that: (1) For the same specimen of copper and for the same period of constant annealing, the variation in height is negative, zero, or positive, according to whether the temperature is less than, equal to, or greater than a certain limit, which is between 600° and 650° C. for average cold-working; the algebraic value of the variation increases with the temperature. (2) Other things being equal, the variation in height is independent of the amount of cold-working when the temperature of annealing is less than about 550° C.; above this temperature, its value is much greater the more the metal is cold-worked. Above 650° C., the variation in height is always positive.—J. H. W.

XII.—JOINING

(Continued from pp. 256–259.)

The Influence of Antimony on Soft Solder. Anon. (*Z. Metallkunde*, 1932, **24**, 34).—According to the report of the British Non-Ferrous Metals Research Association on soft solders (cf. this *J.*, 1931, **47**, 113), the addition of antimony to soft solder results in a varying increase in the tensile strength, shear strength, and Brinell hardness, and in a decrease in the elongation of the solder. The shear strength of overlapped soldered joints depends on the soldered material: an addition of antimony is favourable for copper, unnecessary for brass, and injurious for iron.—M. H.

Hard Soldering of Aluminium Foil. L. Rostosky and E. Lüder (*Aluminium Applications*, 1930, **2**, (5)).—An abstract from *Hauszeit V.A.W. u.d. Erftwerk A.G. Aluminium*, 1930, **1**, 272–278. See this *J.*, 1931, **47**, 295.—J. C. C.

Soldering of Aluminium Foil. Anon. (*Aluminium Broadcast*, 1930, **2**, (18)).—The directions for using the Rostosky soft solders are summarized and commented on. The solder was found to contain 59·3% tin and 40·6% zinc, and to withstand the boiling test for 3½ hrs. only. It is recommended by Rostosky that the flux should be left on the joint as a protection against corrosion. If indirect heating with accurate temperature control is available, hard soldering with non-corrosive solders is possible.—J. C. C.

Aluminium and its Welding. A. Voronin (*Avtogennoe Delo* (*Autogenous Industry*), **1930**, (3), 14–16; *C. Abs.*, 1932, **26**, 70).—[In Russian.] The operation of welding aluminium is described. The following flux compositions are recommended:

No.	KCl. %.	NaCl. %.	LiCl. %.	NaF. %.	KF. %.	$KHSO_4$. %.	$NaHSO_4$. %.	K_2SO_4. %.	Na_2SO_4.
1	45	30	15	...	7	...	3	...	...
2	62·7	12·5	20·8	...	...	4	...	...	...
3	33·4	...	33·3	33·3	...	...	...	...	...
4	79	16	...	...	...	...	...	5	...
5	83	17	...	...	...	...	...	...	...

—S. G.

Welding and Cutting Metals with Gasoline Gas and Oxygen. I. Trofimov and V. Korepanov (*Groznenskii Neftyanik*, 1931, 1, (8/10), 96–102; *C. Abs.*, 1932, 26, 681).—[In Russian.] Less petrol vapour is consumed in cutting metals than acetylene. The flame temperature of the petrol vapour is approximately 3000° C., whilst that of acetylene is 3650° C. This causes the metal to burn, thus producing faulty seams. Overheating, which is easily caused by acetylene–oxygen mixtures, causes a change in the structure of the metals, decreasing their strength. Various metals were welded successfully with petrol, requiring smaller quantities of fuel. Various calculations are given. —S. G.

Electric Arc Welding. E. F. Newell and W. E. Quino (*Contact*, 1931, 11, 185–192; *Power Fuel Bull.*, 1931, (5), 103):—The article commences with a short outline of the historical side of welding. It refers to the advent of the "Quasi-Arc" electrode which comprises a "specially robust and protective flux," and to the fact that a.c. plant now universally used, being static, gives no difficulties in operation, nor does it for repairs, as is often the case with a d.c. plant involving rotary transformation in the supply of current. A description of modern arc-welding plant follows, with details of operation; this includes the subject of d.c. application. The principles of welding; characteristics of electrodes; structure of welds; and the testing of welds are embodied in the first half. The second half deals with types and strength of various forms of welded joints and tests of welded joints; welding as applied to oil- and petrol-tanks; ship and boiler repairs; new boiler construction; gas-works construction and repair work and general construction work. Photographs of various test results and other explanatory illustrations are given. A full report of a discussion of the subject by members of the Association of Supervising Electrical Engineers concludes the article.—S. G.

Metal Electrodes for Arc Welding. G. Magnitzkii (*Avtogennoe Delo* (*Autogenous Industry*), 1931, (5), 3–4; *C. Abs.*, 1932, 26, 71).—[In Russian.] Electrodes having the following compositions were prepared:

No.	Carbon. %.	Manganese. %.	Silicon. %.	Sulphur. %.	Phosphorus. %.
1	0·06–0·08	0·15–0·35	0·04–0·08	up to 0·04	0·4
2	0·13–0·22	0·4–0·6	0·08	,,	0·4
3	0·23	0·35	0·4–0·6	,,	0·4
4	0·6–0·75	0·5–0·8	0·3	,,	0·4
5	1·0–1·35	11·0–14·0	0·1–02	,,	0·4

Electrodes used in welding with a.c. were covered with the following compositions: (1) water glass 10, chalk 90%, and water sufficient to obtain the required consistency; (2) water glass 10, aluminium 3, magnesium 2%, and a sufficient amount of water; (3) chalk 75, magnesium oxide 2, graphite 10, aluminium powder 3, water glass 10%, and a sufficient amount of water: (4) C.P. potassium carbonate 1000, zinc oxide 100, sodium silicate 100, K_2MnO_4 25, water 100 grm., water glass 100 grm., and sufficient water to prepare a paste. A composition for cold-welding cast iron consists of: a paste of mixed chalk (No. 1) 250, sodium bicarbonate 50, aluminium powder 30, rosin 10, fused borax 10, water glass 200 grm., and water sufficient for a paste. A flux for electrodes for welding cast-iron (by the cold method) is fused borax 89, sodium carbonate 7, aluminium powder 1, and rosin 3%. Cast-iron electrodes have the following composition: carbon 3·5, manganese 1·0, silicon 2·5–3·5, phosphorus 1·0, sulphur below 0·08%. Copper electrodes contain: copper 93·5, zinc 2·9, aluminium 3·3, and iron 0·26%. No covering is used on cast-iron or copper electrodes.—S. G.

Electric Welding of Aluminium by Means of Carbon Electrodes. A. P. Goryachov and R. R. Suiromyatnikov (*Avtogennoe Delo* (*Autogenous Industry*), 1931, (6), 6–8; *C. Abs.*, 1932, 26, 71).—[In Russian.] A flux containing sodium chloride 7·6, potassium chloride 65·1, and lithium chloride 27·3% was found to be very suitable for the work described in the preceding abstract. —S. G.

An Alternating Current Arc Welder. J. B. Gibb (*Elect. J.*, 1931, 28, 665–667; *C. Abs.*, 1932, 26, 682).—The new type of welder with a high-frequency oscillator removes the danger in a.c. welding of dangerously high over-circuit voltage, an unstable arc, and the difficulty of using small currents. The new outfit consists of a welding transformer with means for adjusting the current by small steps, and an oscillator which makes the arc as easy to handle as a d.c. arc. Characteristics are: lightness, cheapness, convenience, safety, ease of operation, and adaptability.—S. G.

Aluminium in Welding Electrodes for Steel. W. J. Thomas (*Aluminium Broadcast*, 1930, 2, (21), 5–6).—A summary of the arguments for and against the use of aluminium wire or powder in composite electrodes for electric welding of steel.—J. C. C.

Progress in Atomic Hydrogen Welding. Samuel Martin, Jr. (*Iron Age*, 1932, 129, 537–540).—Atomic hydrogen provides for welding at 4000° C., as compared with 3600° C. with arc welding and 3200° C. with oxy-acetylene welding. Owing to this higher temperature and the formation of a reducing atmosphere round the weld, a number of non-ferrous metals and alloys can now be welded by this method. Practical examples of some of these, such as brass and Monel metal, are given.—J. H. W.

New Electric Spot Welder. —— (*Electrician*, 1931, 107, 561).—In a new automatic spot welder developed by the British Insulated Cable Co., the period of the passage of the current is controlled by the properties of the material being welded. This is done by means of a differential coil across the electrodes, the current in which varies according to the heat generated in the metals being welded.—S. V. W.

XIII.—WORKING

(Continued from pp. 259–262.)

The Extrusion of Metals.—I–VI. C. A. Colombel (*Rolling Mill J.*, 1931, 5, 355–358; 419–422, 430–431; 479–482, 494–495; 539–542, 599–600; 667–670; 719–722).—Parts I (pp. 355–358) and II (pp. 419–422, 430–431) are devoted to descriptions of Tresca's early experiments on punching and extrusion. In Part III (pp. 479–482, 494–495) are discussed the equipment and methods employed in the extrusion of shapes from non-ferrous metals, particularly aluminium and its alloys. The " direct " and " indirect " processes are compared and contrasted. Part IV (pp. 539–542, 599–600) is devoted to extrusion defects. The rational placing of billets in the container with head next to the die and the need for removal of skulls left in the container if blisters are to be avoided, are particularly emphasized. The production of hollow sections by extrusion is dealt with in Part V (pp. 667–670). The making of tubes by two variants of the " direct " process is described. The first type of press pierces a solid billet, and then extrudes the tube round the piercer nose, which is held protruding through the die. In the second type a billet previously pierced is extruded round a mandrel which forms an extension to the ram. The physical properties obtained in extruded aluminium alloys and their modification by heat-treatment are briefly indicated in Part VI (pp. 719–722). In conclusion C. outlines the process of cold-drawing extruded blooms to obtain finished tubes of accurate dimensions.—A. B. W.

The Extrusion Press in the Working of Non-Ferrous Metals. L. G. Mitchell and H. Stewardson (*Chem. Eng. and Min. Rev.*, 1931, **23**, 460–464).—Abstract of a paper read before the Melbourne University Metallurgical Society. Describes a typical hydraulic extrusion press and the operation of extrusion. The mechanism of the process and defects of the extruded rod, taking various bronze alloys as examples, are discussed.—J. H. W.

The Extrusion of Metals. R. Genders (*Met. Ind.* (*Lond.*), 1932, **40**, 345–349).—The extrusion of soft metals and of brass and other hard metals and alloys is briefly described, and the operation, advantages and disadvantages, and applications of the direct and inverted processes are discussed. Several presses for both processes are illustrated.—J. H. W.

The Manufacture of Flexible Copper Tubes. W. Greiner (*Z.V.d. Kupferschmied.*, 1932, **44**, 37–38).—See *J.*, this volume, p. 191.—M. H.

Nickel–Silver in Rod and Wire. Richard E. Brown (*Wire and Wire Products*, 1932, **7**, 41, 43, 58, 59, 61–63).—An outline of the development of nickel–brass and a description of present methods of rod and wire production, as carried out in a modern plant, are given.—J. H. W.

Calculation of the Residual Tensions in Cold-Drawn Tubes. N. Dawidenkow (*Z. Metallkunde*, 1932, **24**, 25–29).—The methods of detection and calculation of inner tensions in cold-drawn bars and tubes by Kalakoutzky, Heyn and Bauer, Anderson and Fahlman, Sachs, and Fox are critically discussed. A mathematical development of formulæ which allow the complete determination of tangential and axial tensions in cold-drawn tubes is given. The practicability of the author's method is shown by an example.—M. H.

New Rolling Mills for Light Alloys Erected by the Aluminium Industrie A.G. Neuhausen. Anon. (*Aluminium Broadcast*, 1930, **2**, (30), 9–11).—Abstracted from *Schweizerische Bauzeitung*, 1930, **96**, July (supplement). The equipment includes a three-high hot-rolling mill 700/520/700 × 1700 mm. taking cast slabs weighing 100 to 1000 kg., a three-high hot-rolling mill 900/450/900 × 3300 mm. for construction sheet, a three-high strip mill, and a 3000-metric ton wire and tube extrusion press.—J. C. C.

Dressing Rolls in Aluminium Rolling Mills by Hand Grinding. R. J. Anderson (*Rolling Mill J.*, 1931, **5**, 763–766).—Describes the dressing of rolls *in situ* using a shaped wood stick to apply 80–120-mesh emery mixed with grease. A 26 in. × 84 in. roll may take 2 hrs. to dress. Care should be taken to avoid abrasive spreading to the roll necks, and every trace should be removed at the end of the dressing operation by washing with kerosene.—A. B. W.

Metal Lubrication and Roll Cooling in Aluminium Hot Mill Practice. R. J. Anderson (*Met. Ind.* (*Lond.*), 1932, **40**, 221–223).—A further reference to an article in *Iron Age*, 1931, **128**, 1674–1677, already previously noted in part. See *J.*, this volume, p. 190.—J. H. W.

Electric Induction Roll Heaters. R. J. Wean (*Rolling Mill J.*, 1931, **5**, 523–526, 558).—The necessity of preheating rolls to enable even thicknesses to be made is pointed out. An induction heater, consisting of a copper-strip solenoid encircling a pair of rolls, enables preheating to be brought about by eddy currents induced in the rolls. The solenoid, which is arranged for easy installation and removal, is supplied with a.c. at ordinary supply frequencies of 40 to 60 cycles. A step-down transformer is normally required; this must have a large capacity, as the power factor is low. The temperature distribution produced by the heater is very similar to that obtaining at the end of a working period.—A. B. W.

Methods Used for Electrically Preheating Sheet Mill Rolls. Arthur J. Whitcomb (*Rolling Mill J.*, 1931, **5**, 733–736).—A discussion of the relative advantages of various methods of preheating rolls by resistance and induction heaters. W. considers that the conduction type of resistance heater is to be preferred because it is efficient thermally and can be connected as a balanced high-power factor load direct to the normal supply without high-capacity transforming gear. Experiments are cited which show that the temperature gradients set up in rolls heated by conduction from surface elements are no greater than those obtaining in rolls heated by induction.—A. B. W.

Modernizing Rolling Mills Electrically. Anon. (*English Elect. J.*, 1931, **5**, 113–119).—A brief and well-illustrated review of present practice in the operation of various classes of mill based on typical equipments now under construction or recently supplied.—S. G.

The Electrical Driving of Rolling Mills. H. S. Carnegie (*J. Inst. Elect. Eng.*, 1931, **69**, 1279–1291).—The drives referred to in the paper are in general those for mills to roll iron and steel products, but the particulars are in most cases applicable to drives for mills rolling non-ferrous materials. In discussing the auxiliaries in connection with rolling-mill plant reference is made to the induction type of roll heater or electric roll blanket.—S. V. W.

Spinning a Monel Metal Piston. Harry Shaw (*Amer. Machinist* (*Eur. Edn.*), 1932, **76**, 129).—A piston, required to be non-toxic and rustless, was made from a Monel metal tube. The top of the tube was spun over on a lathe to a dome shape and the remainder of the tube squeezed down in a hand press to give 4 thicknesses of metal.—J. H. W.

Removing Automobile Sheet Metal Dents. A. Eyles (*Aluminium Broadcast*, 1930, **2**, (18)).—Abstracted from *British Industrial Finishing*, **1930**, March. Describes the methods of working and the tools required.—J. C. C.

XIV.—FINISHING

(Continued from pp. 262–263.)

The Colouring of Metals. P. A. Collins (*Metal Cleaning and Finishing*, 1931, **3**, 747–749; *C. Abs.*, 1932, **26**, 57).—Formulæ are given for producing such finishes as antique silver, silver gun-metal, matt silver and brown on copper, and verde, Tiffany green, brown, blue, green, black, and blue-black on brass.—S. G.

Surface Improvement of Silver Articles. H. Moser and E. Raub (*Korrosion u. Metallschutz*, 1931, **7**, 134–139).—The colour and resistance to discoloration of silver–copper alloys containing 7·5, 16·5, and 20% copper can be improved by providing the alloys with a surface coating of pure silver which is more resistant to attack by sulphury atmospheres than copper–silver alloys. This surface coating may be produced by plating with pure silver, by pickling in suitable solutions which dissolve copper in preference to silver, and by repeatedly heating to oxidize surface copper, then dissolving the copper oxide in dilute sulphuric acid. The pure silver coating is rendered more resistant to attack by hard burnishing on a mechanical polisher, after which treatment coatings produced by any of the above procedures are as resistant to discoloration as highly polished pure silver.—A. R. P.

Degreasing Metals by the Vapour Process. E. V. D. Wallace (*Met. Ind.* (*N.Y.*), 1932, **30**, 53–55).—From *Monthly Rev. Amer. Electroplaters' Soc.*, 1931, **18**, (12), 6–11. See *J.*, this volume, p. 193.—A. R. P.

Electrolytic Cleaning and Pickling. C. L. Mantell (*Metal Cleaning and Finishing*, 1931, **3**, 785–789; *C. Abs.*, 1932, **26**, 1197).—A detailed outline of the function of electrolytic cleaning and pickling baths.—S. G.

Unusual Applications of Electrolytic Cleaning. C. L. Mantell (*Metal Cleaning and Finishing*, 1931, **3**, 883–886; *C. Abs.*, 1932, **26**, 1197).—The restoration of ancient bronzes and the removal of scale from boiler surfaces, condensers, &c., are dealt with.—S. G.

Testing of Electrocleaners. C. L. Mantell (*Metal Cleaning and Finishing*, 1931, **3**, 945–949; *C. Abs.*, 1932, **26**, 1197).—Methods for determining the conductivity of cleaning solutions of various compositions are outlined.—S. G.

Finishing Aluminium Bodies. Frank Jones (*Aluminium Broadcast,* 1930, **2,** (18)).—Abstracted from *British Industrial Finishing,* **1930,** March. Contains full directions for applying an all-cellulose finish to aluminium motor-car bodies.—J. C. C.

XV.—FOUNDRY PRACTICE AND APPLIANCES

(Continued from pp. 263–269.)

The Principal Factors in the "Castability" of Pure Metals. A. Portevin and P. Bastien (*Compt. rend.,* 1932, **194,** 599–601).—The "castability" of a metal is defined as its aptitude to fill a spiral mould. If $\varLambda$ is the length of the spiral filled, F the freezing point of the metal, Θ the casting temperature, θ the mould temperature, L the latent heat, c the specific heat, and d the density of the metal: $\varLambda = \alpha \cdot \frac{dc(\Theta - F)}{F - \theta} + \beta \cdot \frac{Ld}{F - \theta}$, where α and β depend on the dimensions and nature of the mould, on the height of pouring, and in some undefined manner on the viscosity of the metal. If α and β are constants: (1) the curves $\varLambda = f(\theta)$ are equilateral hyperbolas, as Courty found for Alpax; (2) the curves $\varLambda = f(\Theta)$ are straight lines, the slope of which is a function of the specific heat, which is an important factor. The curves (2) have been traced experimentally for tin, cadmium, lead, zinc, antimony, and aluminium, and it has been established that for a sufficient liquid superheat, the "castability" is a practically linear function of the temperature and that the viscosity is unimportant. The slopes of these curves indicate that the coeff. α varies with different metals and is a function of the viscosity. The surface tension does not appear to be an important factor in "castability."—J. H. W.

The "Castability" of Alloys. A. Portevin and P. Bastien (*Compt. rend.,* 1932, **194,** 850–853).—The factors which determine the "castability" of pure metals having previously been defined (see preceding abstract), the "castability" of certain alloys has now been investigated. Owing to the necessity for maintaining rigorously comparable conditions of pouring, a cast-iron mould was used and low melting-point alloys were employed. The term "F" of the previously deduced equation now represents the temperature of initial solidification, and throughout the experiments the "liquid superheat," $\Theta - F$, was kept constant, Θ being the temperature of pouring. As a first approximation, the "castability" is proportional to $\Theta - F$. Plotting the values obtained against composition on the appropriate equilibrium diagram brought to light the following laws: (1) The "castability" varies inversely as the solidification interval, and is thus greatest when the initial and final freezing points coincide, as in the case of pure metals and eutectics, and least in the case of saturated solid solutions. (2) The "castability" depends on the crystalline form of the solidifying metal, and is much greater when convex crystals (definite compounds) are formed than when dendrites (solid solutions) are obtained. These relations bring out the differences between "castability" and fluidity, which latter is merely a secondary factor, and have enabled the results obtained in the cases of alloys of magnesium with aluminium and copper, which a film of magnesia introduces complications, to be explained. A study of the effect of successive remelting on the "castability" of magnesium alloys shows that this property first increases as a result of variations in chemical composition, reaches a maximum, and then diminishes as the thickening-up of the metal, owing to the presence of oxide and nitride, becomes the predominant factor.—J. H. W.

A Practical Method for Studying the Running Quality of a Metal Cast in Foundry Moulds. C. M. Saeger and A. I. Krynitsky (*Met. Ind.* (*Lond.*), 1932, **40,** 171–174, 197–198).—Abstract of a paper read before the American Foundrymen's Association (*Trans. Bull. Amer. Found. Assoc.*, 1931, 2, (12), 513–532; discussion, 532–540). See *J.*, this volume, p. 124.—J. H. W.

Moulding and Casting Aluminium Shoe Lasts. Anon. (*Z. ges. Giesserei-Praxis: Das Metall*, 1932, 53, 84–85).—The moulding and sand-casting of an aluminium alloy containing aluminium 87·5% and 50 : 50 copper–aluminium 12·5% for shoe-lasts are described.—J. H. W.

Casting of Some Aluminium Alloys and a Trial of their Modification. W. Loskiewicz and E. Perchorowicz (*Przegląd Techniczny*, 1931, 70, 53–62, 77–81, 113–118, 141–145).—The addition of lead, sodium, and cadmium, as modifiers, to aluminium alloys with 8·2% and 12·4% of copper improves the microstructure but not the mechanical properties of the alloys. On the other hand, addition of 0·1–0·25% cadmium to an alloy of aluminium with 4·1% copper, 10·23% zinc, and 0·39% silicon increases the tensile strength from 13·33 to 16·58 kg./mm.^{2}, and the elongation from 3·21% to 4·79%; the cadmium is added at 750° C. 5–10 minutes before casting the alloy in an iron mould. Addition of cadmium to sand castings of the same alloy increases the tensile strength from 13·85 to 15·26 kg./mm.^{2} and the elongation from 5·04 to 6·48%. —Z. J.

Aluminium Alloy Castings. Anon. (*Aluminium Broadcast*, 1930, 2, (22), 25–26).—Summary of an American publication of the British Aluminium Co., Ltd., describing the properties of the principal alloys, and outlining special features of recommended foundry practice.—J. C. C.

The Manufacture of Aluminium Mincing Machines in Chill Moulds. W. Rondo (*Z. ges. Giesserei-Praxis: Das Metall*, 1932, 53, 124–125).—A description is given of the mould and of the method of casting an aluminium alloy containing copper 4, iron 0·5, and nickel up to 1%, for the manufacture of mincing machines.—J. H. W.

Sand-Cast Aluminium Alloys. W. C. Devereux (*Found. Trade J.*, 1932, 46, 172).—Abstract of discussion of a paper read before the Sheffield Section of the Institute of British Foundrymen. Cf. *J.*, this volume, p. 124.—J. H. W.

Practical Hints for Casting Silumin. Anon. (*Z. ges. Giesserei-Praxis: Das Metall*, 1932, 53, 125–126).—If virgin metal is not used for making Silumin, only the best scrap of known composition must be used. The metal is melted in a crucible under close pyrometric temperature control. Refining is effected by modification, 18 grm. sodium being added to each 25 kg. Silumin.—J. H. W.

Melting Secondary Brass in the Reverberatory Furnace.—II. Edmund R. Thews (*Met. Ind.* (*Lond.*), 1932, 40, 217–220).—Cf. *J.*, this volume, p. 265. Brass borings and similar secondary material must be well briquetted after having been dried, freed from oil, and magnetized. The advantages of briquetting are the protection of light scrap from excessive oxidation, ease of transformation, and the possibility of embodying fluxes with the scrap during melting. Many fluxes are marketed as being especially suitable for reverberatory brass melting, but care in their use is required, since certain of them prevent the separation of the oxidized impurities. Phosphor–copper is the most generally used deoxidizing agent. The construction of the reverberatory furnace, the preparation of the hearth, tapping arrangements, melting, additions to the melt, and pouring are discussed.—J. H. W.

Thin-Walled Nickel–Brass Castings. R. Thews (*Z. ges. Giesserei-Praxis: Das Metall*, 1932, 53, 106–107).—The preparation of the metal, the casting operations, and the precautions required in making thin castings of nickel–brass are described. The principal considerations are: (1) the uniformity of the structure of the casting; (2) the zinc content, which depends on the extent of the zinc loss; (3) the purity, and (4) the density of the casting.—J. H. W.

Casting Artistic Metal Work. Anon. (*Met. Ind.* (*Lond.*), 1932, 40, 241–242).—Notes are given on core- and mould-making, mould-facing and casting bronze for decorative and ornamental work.—J. H. W.

Fluxes for Precious Metal Refining. E. T. Ellis (*Brass World*, 1932, **28**, 45–46).—Reproduced from *Met. Ind.* (*Lond.*), 1932, **40**, 170. See *J.*, this volume, p. 266.—J. H. W.

Casting Articles in Zinc and Zinc Alloys. Anon. (*Z. ges. Giesserei-Praxis: Das Metall*, 1932, **53**, 65–66).—Details with regard to the manufacture of zinc and zinc alloy castings are given. Pure zinc is not recommended owing to its large shrinkage, but good results are obtained with an alloy consisting of copper 5, zinc 80, and tin 15%.—J. H. W.

Press-Casting. Charles Pack (*Metals and Alloys*, 1932, **3**, 29–37).—Machines and processes of operation are described for the production of castings by the die-casting, permanent mould, and press-casting methods, and the advantages and disadvantages of each method are discussed. For press-casting the Jacquemont, Polak, and Pack machines have given very satisfactory results; castings can be made in pure zinc, aluminium, magnesium alloys, brasses, and bronzes. Aluminium press-castings are not contaminated with iron as are die-castings, are free from hard spots, and are sound and dense.—A. R. P.

Treatment of Graphite Crucibles in Melting Practice. Richard Thews (*Metallbörse*, 1931, **21**, 1203–1204, 1253).—Practical hints are given for the preservation of graphite (plumbago) crucibles used for melting non-ferrous metals. The chief causes of rapid destruction are charging of cold metal into cold crucibles, presence of moisture in scrap metal melted, use of unsuitable tongs, gripping of large pieces of coke between the tongs and the crucible walls, placing the hot crucible on cold stone or metal, freezing of large quantities of metal in the crucible, adhesion of slag to the outside or inside of the crucible, and cooling of the crucible too rapidly (furnace cooling is desirable).
—A. R. P.

XVI.—FURNACES AND FUELS

(Continued from pp. 269–273.)

Calculation of Wall Losses of Industrial Furnaces. E. Maase (*Feuerfest Ofenbau*, 1931, **7**, 97–102; *C. Abs.*, 1932, **26**, 3).—A discussion of heat losses through walls. Curves and tables of significant values for various materials are given.—S. G.

Temperature Distribution in Industrial Furnaces. Wirt S. Scott (*Elect. J.*, 1931, **28**, 668–672; *C. Abs.*, 1932, **26**, 341).—A comprehensive investigation of electric and fuel-fired furnaces showed wide variations between temperatures as recorded on control charts and those actually existing inside furnaces in operation under normal conditions. The furnaces investigated were all in first-class condition, but varying in age from 3 months to 10 years. An electric furnace can be made to operate with machine-like precision with close temperature control, whereas gas-fired furnaces are not evenly heated.—S. G.

Iron and Steel used in Brass and Copper Mills. H. G. Keshian (*Metallurgist* (Suppt. to *Engineer*), 1931, **7**, 61–62).—A summary of a paper by K. in *Iron Age*, 1930, **126**, 1282–1286, 1359–1360. See this *J.*, 1931, **47**, 55.—R. G.

An Electric Galvanizing Furnace Permits Close Temperature Control. S. Z. Owen (*Elect. J.*, 1931, **28**, 631–632; *C. Abs.*, 1932, **26**, 32).—An electrically heated galvanizing furnace has been installed for work on small castings, conduits, pipes, and similar material in street-lighting equipment. Its rating is 75 kw., 200 v., 3-phase. The vessel weighs more than 2 tons and holds 8 tons (7272 kg.) of spelter. The 6 heating elements, 2 on each side and 1 at each end, are made of nickel–chromium resistance wire supported in porcelain, and are easily removable without disturbing the vessel. The enclosing shell serves as a mounting for insulators, jumpers, terminal boards, and covers, and as a support for an insulated hinged cover. The cover, in 2 halves for convenience in operating, is made by an inner alloy sheet and a top steel sheet, filled in between with 3 in. of mineral wool insulating material. Thermocouple control of the chamber temperature and bath temperature ensure close temperature control.—S. G.

Economy and Thermal Efficiency of Modern Electric Furnaces for the Annealing of Metals. H. Masukowitz (*Z. Metallkunde*, 1931, **23**, 306–309, 335–337).—(1) The following general points are discussed: cost of power supply to annealing furnaces (electricity, generator gas, and illuminating gas), theoretical quantity of heat necessary for the annealing of brass at 600° and 800° C. (current consumption as a function of thermal efficiency), heat losses and heat consumption with special reference to the materials of construction and insulation (kieselguhr is the most satisfactory insulator). (2) The construction is described and the heat consumption and economy are discussed of different types of annealing furnaces characterized by a low current consumption due to a special construction, insulation, and arrangement of the heating wires, &c.; continuous furnaces for annealing metal strips, tubes, and rods; bright annealing furnaces, and a large muffle furnace. The paper contains numerous diagrams and drawings.—M. H.

Electric Furnaces. E. Barfield (*Distr. Elect.*, 1931, **14**, 686–688; *Power Fuel Bull.*, 1931, (6), 137).—An outline is given of the general principles on which electric furnaces are designed and special reference is made to certain specific uses of electric heat. An illustrated description of various types of furnaces suitable for different processes and various industries is given.—S. G.

Automatic Control of Electric Arc Furnaces. S. Ito (*Meidensha Journal* (*Japan*), 1931, **3**, 35–39; *Power Bibliography*, 1931, (6), 7).—[In Japanese.] A new automatic current-controlling equipment for the arc furnace, capable of close regulation, has been developed by Meidensha. The improvement on the method hitherto adopted implies the use of d.c. for the electric motor instead of an a.c. induction motor having a high starting torque. The latter was considered unsatisfactory owing to the fact that severe fluctuation of current through the furnace requires ceaseless operation of electrode, thereby resulting in overheating of the motor. The new device consists of a current balance and a change-over switch, in which one magnet or another receiving impulse from the current balance completes the circuit in proper polarity for the operation of the electric motor. Tests conducted on a 3-phase carbide furnace fed from a basis of a 3-phase 3500-kva. transformer gave a satisfactory result, there being a substantial saving in the time required for restoring the balanced condition after the material had been charged into the furnace. The efficient operation of the furnace and economy in power consumption, due to less fluctuation of temperature inside the furnace, are also advantages gained by the adoption of this control system.—S. G.

The Söderberg Electrode, Oblong Electrodes, and Other New Developments. M. Sem (*Trans. Amer. Electrochem. Soc.*, 1931, **60**, 181–192; discussion, 192–196).—Söderberg electrodes, comprising sheet-iron cylinders or oblong boxes provided with interior iron ribs and filled with "green" carbon electrode paste which is baked during the use of the electrode in the furnace, have been used successfully in all kinds of electrothermal work. There is little to choose between the cylindrical and oblong shapes. Recent developments in the use of these electrodes comprise a continuous and automatic feed for lowering the electrode into the furnace, the "Wisdom ribbon" device for preventing excessive slip, a new binder which cements the particles together without the necessity of ramming, and a new type of flexible cable having an outer metal hose through which cooling water is circulated and carried to the electrode holders. The current carrying capacity of these cables is more than seven times that of the ordinary type.—A. R. P.

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(Continued from pp. 280–283.)

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[Contains the following papers; abstracts of all those of non-ferrous interest have already appeared in *Metallurgical Abstracts*: O. Bauer und M. Hansen: "Der Einfluss von dritten Metallen auf die Konstitution der Messinglegierungen. III.—Der Einfluss von Zinn"; E. Schmid und G. Wassermann: "Über die Anisotropie von Zinkblechen"; O. Bauer und P. Zunker: "Einfluss geringer Mengen von Fremdmetallen auf die Eigenschaften von Raffinadezink"; J. Hengstenberg und G. Wassermann: "Über röntgenographische Untersuchungen der Kaltvergütung des Duralumins"; G. Sachs und W. Stenzel: "Versuche über das Altern von Stahl"; G. Sachs und J. Weerts: "Atomordnung und Eigenschaften"; W. Kuntze: "Struktur, Festigkeit, Stetigkeit"; W. Boas und E. Schmid: "Zur Deutung der Deformationstexturen von Metallen"; E. Schmid und G. Wassermann: "Über die Walztexturen hexagonaler Metalle"; E. Schiebold und G. Siebel: "Studien an Magnesium und Magnesiumlegierungen.—I."; B. Sander und G. Sachs: "Zur röntgenoptischen Gefügeanalyse von Gesteinen."]

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XX.—BOOK REVIEWS

(Continued from pp. 284–288.)

Creep of Metals. By H. J. Tapsell. Roy. 8vo. Pp. xiv + 285, with 97 illustrations. 1931. Leipzig: Humphrey Milford, Bartels Hof, Markt 8; London: at the Oxford University Press (Humphrey Milford). (30*s.* net.)

Nearly a century ago (*Phil. Trans. Roy. Soc.*, 1840) Eaton Hodgkinson at Manchester made a series of tests of the type now known as "creep" tests. These were carried out on cast-iron columns to determine their endurance and distortion under different loads. Since then at different times the property of a metal to deform under constant load or stress has been observed and to some extent investigated. It is only during the last ten years, however, that the phenomenon has been explored in any measure, and especially regarding the influence of temperature which characterizes the phenomenon as now generally understood.

During this period the rapidly growing demand for information on the creep of metals which has arisen in connection with the development of steam-power plant and certain chemical plant has led to much disconnected research in the leading industrial countries and to the creation of a considerable literature. Much of the published information, however, is not readily accessible to engineers, and in any case apparent discordance in results makes it difficult for engineers and others, unless they have made a critical study of the data produced, to obtain a view in correct perspective. There has been a pressing and growing need, therefore, for a treatise written by an authority which would provide a reliable guide and interpretation of the more important published data. This deficiency is now most admirably remedied by Mr. Tapsell's book on "Creep of Metals."

The author, a recognized expert, touches on all the important aspects of his subject, and as he has kept in view its practical applications, the book will prove of special interest and value to engineers. So much of the matter one agrees with and finds commendable that it is difficult in a review to do much more than give an indication of the principal contents, and here and there to make comments. This course we have pursued in the following.

Following an introductory Chapter I, an excellent short review is given in Chapter II of the important features concerned in the short-time tensile test. Acquaintance with this chapter will engender a more precise understanding than is usually found of what the short-time test involves. In Chapter III the author correctly indicates that the subject of this chapter, "General Effects of Overstrain and Creep," is fundamental to a satisfactory understanding of the phenomenon of creep. Because of its importance, more attention might have been given to the subject and a searching examination made of the phenomenon of strain-hardening and softening of metals. Most interesting data are presented, but with little attempt at analysis or co-ordination. Consequently, a reader, finding that both hardening and softening occur under thermal action, may have difficulty in associating either in a rational way with creep. Clearer conception would result if a distinction were made between the phenomena of strain-hardening and of thermal hardening of deformed metal.

A brief but sufficient outline is given in Chapter IV of the characteristics of normal creep curves. A reference in the preceding chapter to the difference between strain-hardening and thermal hardening of deformed metal would have been of assistance in this chapter. A reference is made by the author to our suggested explanation of creep. The extreme cases cited in opposition to our suggestion have little or no bearing upon it. The three stages of the normal creep curve may be predicted from the form of the load extension curve of a metal tested in tension in the ordinary way at low temperatures, *e.g.* mild steel at atmospheric temperature, but in this extreme case the mechanism which determines the form of the curve is different from that which operates in a creep test as generally understood. We would suggest that at any stage of creep under constant stress (this is virtually the condition at any time in a tensile creep test) deformation is taking place without increase in the resistance offered by the material. The strain-hardening, which in the absence of a compensating or softening action would accompany the deformation, must be negatived by softening due to thermal action somewhere in the metal.

In Chapter VI a very useful summary is given of the principal methods that have been introduced for making short-time creep tests. It is rather too early to know what the results obtained by the different methods really mean in comparison with long-time creep test results, and the author does not venture upon this task. Chapter VI is complementary to the preceding chapter, and provides an equally good summary of the methods and equipment used for making long-time creep tests. The author directs timely attention to the early date at which he began the investigation of creep. We would suggest that late publication of much of the important work done by the National Physical Laboratory compared with early publication of foreign researches, has prevented the former receiving due credit. It is probable that whether or not a hyperbolic relationship as suggested by Kerr more nearly represents the results of Dickenson's tests than the linear temperature–log. duration relation suggested by Dickenson must remain a matter of opinion so far as it depends on direct experimental evidence. We consider Dickenson's method to be the more discriminating, however, and more in accord with later evidence (see the author's Figs. 68 and 69, for example).

Chapter VII, on "The Limiting Creep Stress," is most necessary because the term has become well known to engineers, and many have an insufficient knowledge of creep for a satisfactory interpretation to be made. The author's early definition of the term (p. 110) lacks precision, and the later definition (p. 130), "a stress equal to that which produces at some time within a period of about 30–40 days a creep rate of 10^{-5} inch per inch per day may for practical purposes usually be taken as the limiting creep stress," is more definite. Nevertheless, the author apparently is not happy with his definition, for on p. 138 he states, "The definition of limiting creep stress admits the possibility of eventual failure at this stress, more especially at high temperatures. . . ." We fully agree, and accordingly would welcome abolition of the term. The author presents a number of important aspects of the subject of this "chapter." To all who wish to know or must comprehend what significance to attach to the terms "limiting creep stress" this chapter is heartily commended.

A critical and timely analysis is presented, in Chapter VIII, of what is really involved by the several well-known short-time creep tests. In Chapter IX a review is made of the methods employed and results obtained by several investigators in the U.S.A. who have determined stresses on the basis of a specific deformation in a definite time. The limitations of the methods discussed are fairly stated, and the author concludes on a sound note of warning to be borne in mind by those who may wish to employ data determined by the methods described.

"Stress Limits for Absence of Creep" forms the subject of Chapter X. The author's statement, "It cannot be said that the work of any investigator satisfactorily shows whether the maximum stress without creep is zero or has a finite value," will be endorsed by investigators who have made a special effort to secure refinement and accuracy. Unless a new and immeasurably more sensitive method of detecting creep is introduced, the writer doubts whether the question can be settled directly by means of the methods at present employed. Incidentally, the author, in referring to a paper by the writer, suggests an inconsistency of view. The formula referred to—namely, $L = L_0 e^{-b\theta}$—was applied by the writer to the case of creep tests on a particular material, the stress being the same and only the temperature varied. If the formula is applied to the case of different stresses, then L_0 most certainly will depend on the stress. Consequently, contrary to the author's suggestion, the formula does involve a stress factor. In the case of a *true* elastic limit stress and lower stresses the magnitude of the coefficient L_0 would be infinite. The same practical difficulties, of course, are involved in finding a true elastic limit as in determining the stress limit for absence of creep. Fortunately, for engineers, these stresses have no practical importance.

In Chapter XI the "modifying influences on creep" of thermal treatment, hot- and cold-work, structure, intercrystalline failure, oxidation, corrosion, and the use of protective coatings is treated with the importance it deserves. A necessary warning is given, which we endorse—that creep in certain cases may be of secondary importance in determining the service and endurance of metals at elevated temperatures.

Engineers and designers are assisted by Chapter XII in assessing the importance of creep. It is clearly shown that at elevated temperatures the creep behaviour of a metal is the most important and determining mechanical property. Most problems of design are simplified because the possibility of failure by fatigue is greatly lessened, and in many cases it is negligible.

The author presents, in Chapters XIII and XIV, very useful and comprehensive summaries of creep and allied test data by various investigators on ferrous and non-ferrous metals. A small error occurs on p. 236, where Alpax alloy is referred to as a magnesium alloy. This is a modified aluminium–silicon alloy.

The concluding chapter is devoted to design stresses in which guidance of a general character is given. Incidentally, much remains to be done before the selection of working stress can be made as rational in its determination as is the case at temperatures where for practical purposes elastic theory is strictly applicable. This aspect of the subject, however, in the present state of knowledge, scarcely falls within the scope of the author's treatise.

The value of the book is enhanced by a bibliography of the literature relating to the subject.

We would compliment the author on the general excellence and balance of his treatise. It is the best we know, and should be in the hands of engineers and others who by necessity or desire require to be reliably informed on the phenomenon of creep of metals and the present state of knowledge thereof.—R. W. BAILEY.