

METALLURGICAL ABSTRACTS

(GENERAL AND NON-FERROUS)

Volume 1

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Part 7

I.—PROPERTIES OF METALS

(Continued from pp. 285-290.)

Properties of High-Conductivity Oxygen-Free Copper. C. A. Stanwick (*Bull. Nat. Elect. Light Assoc.*, 1932, 19, 558-560, 574).—Electric furnace melting of cathode copper under carefully controlled conditions, and casting into water-cooled moulds, is now practised in order to produce material containing the minimum of oxygen and assaying 99.98% of the metal. All the shapes are cast vertically. The superior quality and remarkable uniformity of the oxygen-free bars are reflected in the wires rolled from them. They withstand the attack of reducing gases at elevated temperatures, and one of the tests demanded is subjection to bending after annealing in hydrogen at 850° C. With adequate protection of the liquid metal from oxidation during welding, it is anticipated that the use of oxygen-free copper should result in welds of better tensile strength and ductility. Hard-drawn oxygen-free copper wire withstands about 80% of the number of bends obtained with annealed electrolytic copper wire. Similar advantages are shown in results for twisting and tensile tests.—W. A. C. N.

† **A Review of Work on Gases in Copper.** O. W. Ellis (*Trans. Amer. Inst. Min. Met. Eng.*, 1933, 106, 487-512; discussion, 512-514).—All the most important work on the solubility of gases in copper and their effects on the properties of the metal are critically reviewed, an excellent summary is given of our present knowledge of the subject, and many suggestions are made for future work to clear up the doubtful points. Although most of the evidence at present available indicates that hydrogen is the chief cause of the troubles met with in the casting of copper under foundry conditions, it is considered that a great deal of evidence has been put forward to show that nitrogen, carbon monoxide, and sulphur dioxide are by no means innocuous.—A. R. P.

* **Diffusion of Hydrogen Through Platinum and Nickel and Through Double Layers of These Metals.** W. R. Ham (*J. Chem. Physics*, 1933, 1, 476-481).—The flow of hydrogen through single sheets of nickel and platinum with atmospheric pressure on the ingoing side and a pressure of 0.1 mm. on the outgoing side follows the empirical relation

$$R = A \cdot ((p_0^{\frac{1}{2}} - p_i^{\frac{1}{2}})/x) \cdot T^{-\frac{1}{2}} \cdot e^{-\epsilon_1/T}$$

similar to that given by Borelius, where p_i is small compared with p_0 , but apparently proportional to p_0 ; with double layers of these two metals the b_1 of the exponential is dependent only on the metal at the outgoing surface, and is the difference between the work of escape from the outgoing surface and the heat of solution of hydrogen in that metal. The kinetic theory flow equation is sufficient to explain the p_i , and the variation of p_i with temperature may be used to compute the work-function at the outgoing surface, and also to obtain values of m/k , where m is the mass of the hydrogen atom and k the Boltzmann constant.—S. G.

* **The Freezing Point of Rhodium.** Wm. F. Roeser and H. T. Wensel [with Edward Wichers] (*U.S. Bur. Stand. J. Research*, 1934, 12, 519-526; *Research Paper No. 676*).—The freezing point of rhodium was determined by

* Denotes a paper describing the results of original research.

† Denotes a first-class critical review.

measuring with a disappearing filament type of optical pyrometer the ratio of brightness of black bodies immersed in freezing gold and freezing rhodium. The rhodium was melted and frozen *in vacuo* to prevent the absorption of gases during melting. Attempts to operate with the rhodium in atmospheres of air and of nitrogen were not successful. The ratio of brightness of black bodies at the freezing points of gold and rhodium was found to be 751 for wave-length 0.6527 μ . This gives 1966° C. for the temperature of freezing rhodium when the gold point is fixed at 1063.0° C. and C_2 at 1.432 cm.deg. The value 1966° C. is probably accurate to $\pm 3^\circ$ C. E. W., in an appendix, deals with the preparation and purity of the rhodium used in this investigation.—S. G.

The Nuclear Spin of Tin. S. Tolansky (*Proc. Roy. Soc.*, 1934, [A], 144, 574–587).—From spectroscopic evidence it is deduced that the nuclear spins of the two main odd isotopes of tin, 117 and 119, are each $-\frac{1}{2}$.—J. T.

Technical Data on Tantalum, Tungsten, and Molybdenum. Fansteel Products Co. (*Fansteel Bull. R.M.* 16, 17, 18; *Bull. B.N.F.M.R.A.*, 1933, (60), 9).—Three leaflets giving tables of physical data, wire sizes and diameters, &c. The leaflet on tantalum also deals briefly with corrosion-resistance to various chemicals.—S. G.

***Optical Constants of the Alkali Metals.** J. Hurgin and N. Pisarenko (*Nature*, 1934, 133, 690).—The values calculated, using the free electron gas model and taking into account the collisions of the electrons with the atomic lattice, are in satisfactory agreement with previously measured values.—E. H.

†Crystalline Structure in Relation to Failure of Metals—Especially by Fatigue. Herbert John Gough (*Proc. Amer. Soc. Test. Mat.*, 1933, 33, (II), 3–114).—The Edgar Marburg Lecture. This lecture provides an admirable and lucid summary of the present state of our knowledge of the crystalline structure of metals and its relation to fatigue. The 9 sections into which it is divided discuss the following aspects of the subject: the nature of fatigue, the preparation of single metallic crystals, crystal structure of metals, the distortion of single metallic crystals under simple static stressing systems, the influence of the intercrystalline boundary on static strength and distortion, the effects of cold-working on single crystals and polycrystalline aggregates, cold-working in relation to crystal structure, failure under repeated cycles of stress in relation to the crystalline structure, comparative behaviour of single crystals and polycrystalline aggregates. A bibliography of 175 references is appended.—A. R. P.

***Dependence of the Yield-Stress (Streckgrenze) of Metals on Temperature in the Neighbourhood of the Melting Point.** W. D. Kuznetsov and N. A. Bolschanina (*Physikal. Z. Sowjetunion*, 1934, 5, 31–39).—[In German.] Results obtained by pressing a steel sphere into polycrystalline samples of the metals tin, bismuth, cadmium, and zinc at various temperatures show that the yield-stress of the metal at the melting point is approximately nil.—J. S. G. T.

†General Properties of Materials at High Temperatures. H. J. Tapsell (*Science et Industrie*, 1934, 18, 106–110).—Following a discussion of the influence of temperature on plasticity, tables are given showing the effect on tensile strength of 5 rates of applying the load, and the effect of prolonged loading at specified temperatures over stated testing periods, for Duralumin, 60:40 brass, lead sheet, a magnesium-manganese alloy, and 3 steels. Load-extension curves are quoted to illustrate the variation with temperature of plastic deformation, and the varying effects of time in conjunction with temperature are also shown graphically. General observations on plasticity are illustrated by a number of generalized time-deformation curves. The phenomenon of “negative slip” or “creep recovery” is briefly considered. Variations in ductility are correlated with inter-crystalline cleavage in certain instances, and the effects of shock and of chemical attack are reviewed briefly.—P. M. C. R.

†**Phenomena Associated with the Prolonged Heating of Metals.** H. J. Tapsell (*Science et Industrie*, 1934, 18, 141-145).—The work of Bailey and Roberts appears to favour an exponential rather than a linear relationship between time of stressing and reciprocal of absolute temperature. The possibility of thermally induced alterations in structure, as in spheroidization and precipitation phenomena, is an important consideration. The effects of the condition of the material at the outset of testing are reviewed; forged non-ferrous materials are stated to show a lower resistance to deformation than cast, below the recrystallization temperature, the latter itself being affected by the degree of cold-working. The influence of grain-size is discussed, with reference to a light alloy and 2 steels. Factors affecting recrystallization temperature are analyzed and summarized. From the difficulty of complete standardization of conditions has arisen the conception of limiting creep stress. A linear relation exists between the logarithms of minimum speed of deformation at points of inflection of creep curves, and logarithms of times required to effect fracture. Time to produce fracture = $\frac{a}{a - \text{creep rate}}$ (a constant). Typical creep curves are shown for 8 steels, and limiting creep curves (time — % creep) are given for 12 ferrous and non-ferrous materials. The National Physical Laboratory creep-testing procedure is summarized and some results of accelerated tests are tabulated.—P. R.

***The Diffusion in Metals.** W. Seith, E. Hofer, and H. Etzold (*Z. Elektrochem.*, 1934, 40, 322-326).—The rate of diffusion of magnesium, cadmium, nickel, and mercury in lead, and of lead and mercury in cadmium has been determined. The diffusion of lead in tin was also investigated, but no numerical results were obtained. The mobility in lead of the metals investigated up to the present decreases in the order: gold, silver, magnesium, cadmium, mercury, bismuth, thallium, zinc.—J. H. W.

Action at a Distance by Metals on Micro-Organisms. G. A. Nadson and C. A. Stern (*Zentr. Bakt.*, 1933, II Abt., 88, 320; and (abstract) *J. Inst. Brewing*, 1933, 39, 660-661).—See *J. Inst. Metals*, 1933, 53, 614, and *Met. Abs.*, this volume, p. 165. Evidence was obtained of the toxic action of metals placed near, but not in actual contact with, micro-organisms. Experiments were made with aluminium, copper, and lead. The toxic influence diminished rapidly with increase in distance between metal and culture; it was significant at 2 mm. for aluminium and 5 mm. for lead. Metallic salts possessed a similar, but less intense, action to their metals. As an explanation of the action, it is suggested that electrons are given off by the metal under the influence of the radio-activity of the surrounding medium.—H. W. G. H.

Safeguarding Ancient Buildings—The Death-Watch Beetle. A. N. Cathcart (*Keystone*, 1933, (2), June, 7 pp.).—Lead is not a satisfactory covering for roofs and gutters, since it usually allows moisture to penetrate into the woodwork, and damp wood is essential for the development and multiplication of the death-watch beetle. Well-laid copper with welted joints and efficient ventilation of the timbers will effectually prevent the attacks of the beetle.

—A. R. P.

Safeguarding Ancient Buildings. Some Notes on Roof Decay and Its Prevention. A. N. Cathcart (*Keystone*, 1934, (3), April, 6 pp.).—Examples are quoted of lead roofing being perforated by the death-watch beetle. Copper sheet is never touched by the beetle, and copper also appears to be toxic towards the insect; the substitution of this metal for lead in roofing work is therefore strongly advocated.—A. R. P.

Fourth Report of the Atomic Weights Commission of the International Chemical Union. G. P. Baxter, (Mme.) P. Curie, O. Hönigschmid, P. Lebeau, R. J. Meyer (*Ber. deut. chem. Ges.*, 1934, [A], 67, 47-67).—Revised values for

atomic weights are accepted for potassium, arsenic, selenium, indium, tellurium, caesium, ytterbium, osmium. Summarized accounts are given of investigations bearing on the atomic weights of the foregoing elements, and also on those of carbon, nitrogen, silicon, sulphur, thallium, lead, tantalum, and niobium.—P. M. C. R.

***The Atomic Weights of Radioactive Substances.** Forrest Western and Arthur E. Ruark (*J. Chem. Physics*, 1933, 1, 717-722; *C. Abs.*, 1934, 28, 405).—The atomic weights of lead isotopes, 206, 207, and 208 are obtained in 3 independent ways from chemical and mass-spectrograph data. They are 205.98, 206.98, and 207.98 \pm 0.03. By adding the mass lost in disintegration in the form of α - and β -particles and γ -rays, atomic weights of all known radioactive substances are obtained.—S. G.

The Theory of Liquid Metals. S. Schubin (*Physikal. Z. Sowjetunion*, 1934, 5, 81-105).—[In English.] The significance of the presence of conductivity electrons in liquid metals and the interpretation of the existence of a residual resistance of metals independent of temperature in the case of liquid metals are discussed mathematically.—J. S. G. T.

Electrical Conductivity at Low Temperatures. S. V. Vonsovsky and A. A. Smirnov (*Physikal. Z. Sowjetunion*, 1934, 5, 115-130).—[In English.] Using the model of a metal proposed by Kronig and Penny, the authors show that, for low temperatures the resistance of a metal at T° is given by an expression of the form $aT^5 + bT^4 + cT^3$.—J. S. G. T.

The Explanation of Supraconductivity. J. Frenkel (*Nature*, 1934, 133, 730-731).—Theoretical.—E. S. H.

The Laws of Variation of Resistance of Metals with Temperature: Their Application to Industrial Measurements. — Jouaust (*Bull. Soc. franç. Elect.*, 1934, [v], 4, 437-445).—The work of Matthiessen, Onnes, Brillouin, and others is reviewed. J. considers that dimensional variations and local and general straining vitiate resistivity determinations, and advocates the substitution in specifications of temperature coefficients for those of resistivity.

—P. M. C. R.

II.—PROPERTIES OF ALLOYS

(Continued from pp. 290-298.)

***The Fatigue Properties of Light Metals and Alloys.** R. L. Templin (*Proc. Amer. Soc. Test. Mat.*, 1933, 33, (II), 364-380; discussion, 381-386).—For an abstract of the paper see *J. Inst. Metals*, 1933, 53, 489. In the discussion J. A. Crann presented a table showing the fatigue-endurance values of magnesium alloys based on 500 million cycles as well as the ordinary tensile properties and the ratio endurance limit (L_E)/tensile strength (S_T). In the aluminium-manganese-magnesium alloys L_E increases with the percentage of aluminium both in cast and wrought alloys, whilst L_E/S_T varies for the cast alloys from 0.2 to 0.4 with a mean value of 0.25, and for wrought alloys from 0.31 to 0.38 with a mean value of 0.35; this ratio also tends to increase with increasing aluminium content. Heat-treatment appreciably increases S_T , but has little influence on L_E in the case of the ternary alloys with 8-12% aluminium. Weight for weight, magnesium alloys have a better fatigue-endurance limit than have aluminium alloys. Further discussion took place on the relative value of long and short time endurance tests and on the need for making fatigue tests under more than one type of stress.—A. R. P.

Aluminium R.R. 53 B. Anon. (*Met. Ind. (Lond.)*, 1934, 44, 257; and *Aircraft Engineering*, 1934, 6, 50).—A short note. The particular applications of Aluminium R.R. 53 B, a slightly modified alloy of the "R.R. 53" type, are for fast-moving parts in the electrical industry and for smaller castings in aircraft construction. Its proof stress, maximum stress, elongation %, and

Brinell hardness for sand-cast test-bars "as cast," solution treated, and artificially aged are tabulated. Its composition is: copper 2.5, nickel 1.5, magnesium 0.8, iron 1.2, and silicon 1.2%. Its density is about the same as that of "R.R. 53."—J. H. W.

***Influence of Heavy Metals on Aluminium Alloys.** P. Röntgen and W. Koch (*Light Metals Research*, 1934, 2, (48), 11–18).—Translated from *Z. Metallkunde*, 1934, 26, 9–13. See *Met. Abs.*, this volume, p. 168.—J. C. C.

***The Influence of Heat-Treatment and Long-Period Ageing on the Properties of an Aluminium Alloy.** W. Schwinning and E. Dorgerloh (*Light Metals Research*, 1934, 2, (49), 3–7).—Translated from *Z. Metallkunde*, 1934, 26, 91–92. See *Met. Abs.*, this volume, p. 291.—J. C. C.

***The Hardness of Aluminium-Rich Binary Alloys in Relation to the Concentration of the Addition Metal.** K. Roth (*Light Metals Research*, 1934, 2, (49), 8–21).—Translated from *Z. anorg. Chem.*, 1930, 191, 181. See *J. Inst. Metals*, 1931, 47, 8.—J. C. C.

***The Cobalt-Tungsten System.** W. P. Sykes (*Trans. Amer. Soc. Steel Treat.*, 1933, 21, 385–421; discussion, 421–423).—A tentative constitutional diagram has been constructed from data furnished by micro-examination, diffraction patterns, thermal analyses, and determinations of electrical resistance. Cobalt dissolves 35% tungsten at 1465° C., the temperature of the eutectic. The solid solubility decreases to about 3% tungsten at 550° C. The eutectic occurs at a composition near 46% tungsten and consists of the cobalt-rich solid solution (β) + an intermediate phase (δ) represented by the formula WCo (75.7% tungsten). This latter phase is formed on cooling by a peritectic reaction between the tungsten-rich solid solution (dissolving 0.2–0.3% cobalt) and the cobalt-rich liquid. A second intermediate phase (ϵ) forms at 1100° C. as the result of a peritectoid reaction between δ and the cobalt-rich solid solution β . It approximates in composition to the formula Co_2W_3 (47.1% tungsten). The cobalt-rich solid solutions are subject to age-hardening above 500° C. A maximum hardness of Rockwell C 65 (Brinell 770) has been observed as a result of ageing at 600° C. for 200 hrs. a rolled alloy containing 35% tungsten. The hardness developed by ageing is unusually persistent at temperatures as high as 700°–750° C.—S. G.

†**Development of Adnic. A Corrosion- and Heat-Resisting White Metal Alloy.** William B. Price (*Metals and Alloys*, 1934, 5, 71–73). **Adnic. A White Metal Alloy for Corrosion-Resistance and for Moderate Temperature Heat-Resistance.** William B. Price (*Ibid.*, 77–81).—(I.—) An account of the research work which resulted in the production of Adnic. (II.—) The best physical properties of Adnic are obtained with a composition of nickel 29, copper 69–70, tin 1, manganese 0.1–0.25, iron not more than 0.25, silicon less than 0.05, and carbon less than 0.04%. Recrystallization of the severely cold-worked metal starts at 560° C. The 70 : 29 : 1 Adnic alloy in the form of $\frac{1}{2}$ -in. hard-rolled rod has an elastic limit of 85,000, a yield-point of 107,000, and tensile strength of 113,200 lb./in.² with an elongation of 10%, a reduction in area of 56.5%, and a scleroscope hardness of 31. The coeff. of thermal expansion is 0.0000163; melting point 1205° C., and the density 0.321 lb./in.³ at 68° F. (20° C.). Other data are shown graphically, and include the effect of annealing and cold-drawing on the various properties, and the creep characteristics at high temperatures. Data on corrosion tests in various media are tabulated and comparisons made with the behaviour of bronzes and plain cupro-nickel alloys.—A. R. P.

***Influence of Silver on the Softening of Cold-Worked Copper.** H. C. Kenny and G. L. Craig (*Metals Technology*, 1934, (Jan.), 1–8, *A.I.M.M.E. Tech. Publ.* 525).—The temperature at which cold-worked copper softens on annealing is raised by very small amounts of silver, and this effect has been studied for various Lake coppers containing from 0.048 to 0.068% of oxygen. Rockwell

hardness tests and tensile tests on wire specimens were carried out on alloys after long and short anneals at temperatures between 150° and 325° C. The loss in strength by softening during tinning was investigated by immersing tensile specimens for 10 seconds in a 60:40 lead-tin bath at 360° C. The softening temperature increases rapidly with the silver content up to 10 oz. per ton (0.034%), and then comparatively slowly. Cold-worked copper free from silver is almost completely softened after a few days at 150° C., whilst copper of the same hardness but containing 10 oz. of silver per ton is not greatly softened after 1 year. These small amounts of silver do not affect the mechanical properties, and have no appreciable effect on the conductivity.

—W. H. R.

***Transformations in the Copper-Tin Eutectoid Alloys.—I.-II.** (I.) I. Isaitchew and G. Kurdjumow. (II.) W. Bugakow, I. Isaitchew, and G. Kurdjumow (*Physikal. Z. Sowjetunion*, 1934, 5, 6-21, 22-30).—[In German.] (I.—) By annealing copper-tin eutectoid alloys, the β -phase is not changed directly into the α - and γ -phases; an intermediate γ' -phase is first produced. This γ' phase is characterized by a cubic lattice cell having a parameter approximately half that of the γ -phase; it is, however, possible that it is characterized by an hexagonal axis; in that case the axial ratio is 0.35. The orientations of the respective phases are briefly discussed. (II.—) The effect of temperature of annealing on the crystal structure, minute structure, and electrical resistance of the copper-tin alloys is investigated. The production of an intermediate, γ' , phase from the β -phase during annealing is marked by the lower electrical resistance and greater corrodibility characterizing this intermediate phase. The martensitic intermediate β' phase is produced by quenching under definite conditions; it is not produced from the β -phase by annealing. Temperatures at which structural changes occur are about 75° C. lower when powders are used than when massive samples or single crystals are used.

—J. S. G. T.

***Strength and Ageing Characteristics of the Nickel-Bronzes.** E. M. Wise and J. T. Eash (*Metals Technology*, 1934, (Jan.), 1-25, *A.I.M.M.E. Tech. Publ.* 523).—The mechanical properties of nickel-bronzes have been investigated for alloys containing up to 20% nickel and 13% tin. Tensile properties, Brinell hardness, and fatigue strengths were investigated for (a) sand-castings, (b) alloys homogenized at 1400° F. and aged at lower temperatures, and (c) rolled alloys prepared from specimens annealed at 1400° F., and aged at different temperatures. With the prices of copper, nickel, and tin at the ratios of 9:35:50, the replacement of part of the tin in bronze by nickel offers attractive savings in cost, together with equal or better mechanical properties. Remarkable tensile strengths of the order 135,000 lb./in.² for annealed and aged alloys, and 170,000 lb./in.² for hard-rolled and aged alloys, can be obtained. Curves are given showing properties for alloys of constant cost based on the above price ratio. The effects of small additions of zinc, chromium, iron, silicon, and lead to the 7.5% nickel, 8% tin alloy were also studied.—W. H. R.

The Effect of Sulphur and Iron on the Physical Properties of Cast Red Brass (85 Cu, 4 Sn, 5 Zn, 5 Pb). H. B. Gardner and C. M. Saeger, Jr. (*Proc. Amer. Soc. Test. Mat.*, 1933, 33, (II), 448-458; discussion, 459-461).—For abstract of the paper see *J. Inst. Metals*, 1933, 53, 492. In the discussion O. E. Harder made suggestions for improving the foundry technique so as to avoid irregularities in the mechanical properties of this type of alloy. In reply, H. B. G. suggested that the irregularities were due to unsuitable pouring temperatures.—A. R. P.

***Note on Frictional Resistance of Steel and Brass in Shrink Fits.** W. H. Swanger (*Amer. Soc. Test. Mat. Preprint*, 1934, June, 1-7).—The making of shrink fits by refrigerating the inner member offers an easily accomplished alternative when the converse method of expanding the outer member by heat is not practicable or permissible. S. presents data on the resistance to axial

slip developed between cylindrical rings 1 in. long and 1 in. in diameter assembled on pins which at room temperature were about 0.0015 in. larger in diameter. Prior to assembly the pins were contracted by cooling to -80°C . in a bath of acetone containing dry ice. Three combinations of material were used: (1) a brass ring on a brass pin; (2) a steel ring on a brass pin; and (3) a steel ring on a steel pin. The resistance to slip was in part dependent on the amount of "oversize" of the pin but was considerably increased when seizing occurred between the contacting surfaces.—S. G.

Silicon-Brasses. W. Dickie (*Met. Ind. (Lond.)*, 1934, 44, 510).—A short letter casting doubt on the real cheapness of silicon-brasses owing to contamination of other non-ferrous borings and scrap.—J. H. W.

Kunial Alloys. [H. W.] Brownson (*Met. Ind. (Lond.)*, 1934, 44, 211-212).—An abstract of an address. The principal physical properties of Kunial brass and copper in the quenched, quenched and tempered, cold-rolled, and cold-rolled and tempered states, and their tempering temperatures and corrosion-resistance, are given in diagrams.—J. H. W.

A New Series of Copper Alloys [Kunial]. Anon. (*Met. Ind. (Lond.)*, 1934, 44, 189-190; also *Metallurgia*, 1934, 9, 113; *Machinist (Eur. Edn.)*, 1934, 78, 81-82 E; *Overseas Eng.*, 1934, 7, 220).—Describes the properties of Kunial brass, copper, nickel-brass, and bronze alloys, which are said to have 3 times the hardness and twice the tensile strength of ordinary copper alloys when annealed at 400° - 600°C .—J. H. W.

***Refining [the Structure] of Lead-Antimony Alloys.** V. Montoro (*Met. italiana*, 1933, 25, 741-747; *Chem. Zentr.*, 1934, 105, I, 2646).—Addition of 0.2% of sodium to antimonial lead containing 6-16% antimony results in a considerable increase in hardness and a change in the microstructure. Apparently a ternary eutectic is formed which is harder than the binary lead-antimony eutectic.—A. R. P.

Improved Magnesium Alloys. Anon. (*Iron Steel Canada*, 1934, 17, 23).—A short note briefly describing the properties of ternary magnesium alloys containing aluminium 4-10 and zinc 3-1%.—J. H. W.

***Alloys of Iron, Manganese, and Carbon. V.—Microscopic Studies of Binary Iron-Manganese Alloys.** V. N. Krivobok and Cyril Wells (*Trans. Amer. Soc. Steel Treat.*, 1933, 21, 807-820).—Deals with the characteristic microstructures of a series of fairly pure iron-manganese alloys, varying in composition from 100% iron to 100% distilled and remelted manganese. The nature of the constituents is described and illustrated by photomicrographs. Thus the proof is offered, augmenting the dilatometric and X-ray studies of the same alloys already published, that the iron-manganese system does not form a continuous series of solid solutions, but contains several phases, not all of which, however, have been distinguished microscopically.—S. G.

***Alloys of Iron, Manganese, and Carbon. VI.—Factors Affecting Transformations in the Binary Iron-Manganese Alloys.** Francis M. Walters, Jr. (*Trans. Amer. Soc. Steel Treat.*, 1933, 21, 821-829).—There are a number of factors which affect the completeness of an allotropic transformation and its temperature range. This paper gives the effect on the binary iron-manganese alloys of 3 of these factors, namely, heterogeneity, deformation and heating rate through the α to γ transformation range.—S. G.

***Alloys of Iron, Manganese, and Carbon. VII.—Influence of Carbon on Thirteen Per Cent. Manganese Alloys.** Cyril Wells and Francis M. Walters, Jr. (*Trans. Amer. Soc. Steel Treat.*, 1933, 21, 830-845).—The 13% manganese section of the ternary phase diagram has been determined by the examination of specimens brought to substantial equilibrium at crucial temperatures. It was found that a soak of at least 8 hrs. near the solidus was necessary to bring about a satisfactory distribution of manganese in the forged alloys. ϵ as well as α was found as a low-temperature decomposition product.—S. G.

***Alloys of Iron, Manganese, and Carbon. VIII.—Influence of Carbon on Ten Per Cent. Manganese Alloys.** John F. Eckel and V. N. Krivobok (*Trans. Amer. Soc. Steel Treat.*, 1933, 21, 846-864).—This investigation deals with pure alloys containing iron, 10% manganese, and carbon, the latter varying from 0.01 to 1.4%. These alloys represent the 10% manganese section of the iron-manganese-carbon ternary system. The phase diagram at substantial equilibrium was determined, and is included in the paper. The phases present are the γ -solid solution, α -solid solution, and carbides. The ϵ -phase found in some alloys in small amounts is not included in the phase diagram. The methods used for the determination of the boundary limits for various fields are described. In addition, extra diagrams are given showing the influence of composition and previous heat-treatment on the decomposition of the γ -phase. No mechanical properties have as yet been determined, but a summary of variation in hardness brought about by different treatments is included.—S. G.

***Alloys of Iron and Manganese. IX.—Transformations and Heterogeneity in the Binary Alloys of Iron and Manganese.** Francis M. Walters, Jr. (*Trans. Amer. Soc. Steel Treat.*, 1933, 21, 1002-1013; discussion, 1013-1015).—See *J. Inst. Metals*, 1933, 53, 624.—S. G.

***Alloys of Iron and Manganese. X.—Thermomagnetic Analysis of the Binary Alloys of Iron and Manganese.** F. M. Walters, Jr., and John F. Eckel (*Trans. Amer. Soc. Steel Treat.*, 1933, 21, 1016-1020).—The variation of magnetism with temperature was observed with a ballistic galvanometer. The effect of manganese on ferrite is to decrease its magnetism moderately. Alloys containing 16% manganese and above are practically non-magnetic because the two phases of which they are composed, γ and ϵ , are non-magnetic. Evidence, hitherto lacking, was found for an ϵ - α transformation.—S. G.

***Alloys of Iron and Manganese. XI.—The Variation of Electrical Resistance with Temperature in Binary Alloys of Iron and Manganese.** F. M. Walters, Jr., and Cyril Wells (*Trans. Amer. Soc. Steel Treat.*, 1933, 21, 1021-1027).—The electrical resistance of binary alloys of iron and manganese containing between 0 and 29% manganese was measured from 25° to 1000° C. It was found that manganese greatly increases the resistance and decreases the temperature coeff. of α -iron. Manganese was found to have very little effect on the resistance of γ -iron, which at 1000° C. is almost independent of the manganese content.

—S. G.

***Alloys of Iron and Manganese. XII.—Alloys of Iron and Carbon with 2.5 and 4.5 Per Cent. Manganese.** M. Gensamer (*Trans. Amer. Soc. Steel Treat.*, 1933, 21, 1028-1034).—The 2.5 and 4.5% manganese sections of the constitutional diagram of the ternary system iron-manganese-carbon, with carbon up to 1.3%, have been drawn from data obtained by the study of 12 alloys prepared with great care from materials of high purity. The results show that the recent work of Bain, Davenport, and Waring (*Trans. Amer. Inst. Min. Met. Eng.*, 1932, 100, 228) on alloys of commercial purity are substantially correct—no important differences were observed between their results for alloys of commercial purity and the much purer alloys used in this study.—S. G.

***A Comparison of Certain White-Metal Bearing Alloys, Particularly at Elevated Temperatures.** C. E. Swartz and A. J. Phillips (*Proc. Amer. Soc. Test. Mat.*, 1933, 33, (II), 416-425; discussion, 426-429).—For abstract of the paper see *J. Inst. Metals*, 1933, 53, 495. In the discussion L. C. Blomstrom and E. R. Darby reported the results of some tests made on an antimonial zinc-cadmium alloy in an American car; the tests showed that this alloy was much superior to tin-base Babbitt metals in continuous running at high speeds. H. W. Crillett suggested that adverse criticism of the behaviour of zinc-cadmium bearing metals was directed solely against the eutectic alloy, which contained no hard constituent such as was present in tin-base bearing metals; this constituent could be introduced by addition of antimony, whereby structures closely resembling those of tin-base Babbitts could be obtained.—A. R. P.

*The Effect of the Addition of Lead on the Hardness of Certain Tin-Base Bearing Alloys at Elevated Temperatures. J. N. Kenyon (*Proc. Amer. Soc. Test. Mat.*, 1933, 33, (II), 430-444; discussion, 445-447).—For abstract of the paper, see *J. Inst. Metals*, 1933, 53, 495. In the discussion H. K. Herschman pointed out that hardness values do not always indicate the suitability of a bearing metal for service, and questioned the effect of lead on the hardness at 75°-100° C. In reply J. N. K. quotes figures showing that 3-4% lead increases the hardness of copper-antimony-tin alloys by about 10-20% at 25° C. and by 3-8.8% at 100° C. Tabulated results on the effect of mould temperatures of 25°, 76°, 176°, and 206° C. on the hardness of tin-base Babbitts with and without lead are given, which show that mould temperature has little effect on the temperature-hardness relations except in the case of alloys with a high antimony content. More than 2% lead was found to cause crumbling at 200° C. in an alloy of tin 89, antimony 7.5, and copper 3.5%.—A. R. P.

Special White Metal Alloys. E. Richards (*Metallbörse*, 1934, 24, 17-18, 49-50, 81-83, 113-114, 146).—An alphabetical list of tin- and lead-base bearing metals giving compositions and uses.—A. R. P.

The White Alloys of Tin. III.—Pewter. Anon. (*Tin*, 1934, (April), 19-22).—See *Met. Abs.*, this volume, p. 174. Although old pewters contain a very varied amount of tin, modern pewter usually contains not less than 95% tin. The properties of such alloys, to which small quantities of copper and antimony are added as hardeners, are described.—J. H. W.

*A Microscopic Examination of Iron-Tin Reaction Products. W. D. Jones and W. E. Hoare (*Iron Steel Inst. Advance copy*, 1934, May, 1-8).—The existence of 3 intermetallic compounds in the iron-tin system has been confirmed. These are considered to be of compositions indicated approximately by the formulæ: Fe_2Sn , FeSn , FeSn_2 . The existence of the compound FeSn is supported by evidence additional to that advanced by the work of Edwards and Preece. The γ -phase of Ehret and Westgren has not been confirmed. The investigation indicated that the iron-tin system requires further elucidation.—S. G.

*The Intermediate Phases of the Iron-Tungsten System. W. P. Sykes and Kent R. Van Horn (*Trans. Amer. Inst. Min. Met. Eng.*, 1933, 105, Iron Steel Div., 198-212; discussion, 212-214).—For abstract of the paper see *Met. Abs.*, this volume, p. 125. In the discussion O. E. Harder and W. P. S. consider the merits of the sintering process of making alloys for investigating phase equilibria, and point out the necessity for very prolonged heating to ensure complete diffusion of the constituents and the attainment of stable equilibrium.—A. R. P.

*Contribution to the Knowledge of the System Iron-Tungsten. Otto Landgraf (*Forschungsarb. Metallkunde u. Röntgenmetallographie*, 1933, (12), 33 pp.; *Chem. Zentr.*, 1934, 105, I, 2971-2972).—The alloys were made by melting the constituents in an atomic hydrogen flame using tungsten electrodes to avoid absorption of carbon. Heat-treatment was carried out in a surface combustion furnace. X-ray and micrographic examinations established the existence of the following fields: (i) α -iron containing 0% tungsten at 20° C. to 23% tungsten at 1530° C.; (ii) a closed γ -field; (iii) the compound Fe_3W_2 ; (iv) a eutectic between α -iron and Fe_3W_2 containing 33% tungsten; (v) tungsten containing a small quantity of Fe_3W_2 in solid solution, and (vi) a duplex field containing tungsten and Fe_3W_2 . Notes on the Brinell hardness, density, and microstructure are given.—A. R. P.

*Zinc Die-Casting Alloy Ageing Data. E. A. Anderson and G. L. Wesley (*Metals and Alloys*, 1934, 5, 97-99, 102).—Modern zinc-base die-casting alloys made from 99.99% zinc and containing aluminium 4.1, magnesium 0-0.04, and copper 0-2.9% shrink steadily at 20° C. during the first 4-5 weeks after casting, but at 95° C. shrinkage is completed in a few hours. Certain of the alloys aged at room temperature expand again after 6 months to 2 years, but when aged at higher temperature subsequent expansion is prevented; on the other hand,

other alloys may be permanent after normal ageing, but subject to growth after accelerated ageing. In any case, the changes are very small, and of importance only when the tolerance is of the order of 0.0001 in. Changes in tensile strength and ductility during ageing are relatively small after the first few hrs. The steam test for intergranular corrosion has been critically examined, and the results obtained with several alloys within the above composition range are discussed.—A. R. P.

***Dimensional Changes in Die-Casting Alloys. Metastable Beta Phase in Aluminium-Zinc Alloys.** R. G. Kennedy, Jr. (*Metals and Alloys*, 1934, 5, 106-109, 112).—The properties of β -aluminium-zinc alloy (21.7 : 78.3) made from aluminium containing less than 0.02% of impurities and zinc with less than 0.0001% of impurities have been investigated. After prolonged annealing at 350° C. and quenching in ice-water, the temperature increases slowly for 2 minutes, then sharply to a maximum at 4 minutes; in alloys with more zinc than corresponds with pure β this heat evolution takes place more rapidly. Similar changes occur in the hardness of the β alloy after quenching, maximum hardness being attained in 6 minutes; this maximum is followed by a sharp decrease to the value after quenching in 15 minutes, then by a slow decrease during several days. Practically no contraction occurs after the first 1-2 days at room temperature. X-ray examination of β at above 350° C. indicates a cubic lattice and a simple solid solution, not the compound Al_2Zn_3 .—A. R. P.

Heat-Resistant Alloys. — Piwowarsky (*Congrès du Chauffage Industriel* (Preprint), Group 1, Sect. 3, 1933, 8 pp.; *Bull. B.N.F.M.R.A.*, 1933, (60), 15).—A survey of recent research. A useful tabular summary is included of compositions of various Continental heat-resistant alloys, giving the name of the manufacturer and the special property claimed. Alloys mentioned are Sieromal, Contraacid, Megapyr, Thermax, Alferon, Pyrodur, Niresist, Ferrotherm, and Nicrotherm.—S. G.

Special Alloys. Anon. (*Z. ges. Giesserei-Praxis: Das Metall*, 1934, 55, 78, 122, 164).—Cf. *Met. Abs.*, this volume, pp. 125 and 172. The composition, preparation, and properties of the alloys Elektrum, Elephanten-S-bronze, Elinvar, Elmarid, Emerald-bronze, Elkonit, Elektron, Engestrium, Emperor bronze, and Erhards' War Bronze (Kriegsbronze) are described.—J. H. W.

Notes on the Ageing of Metals and Alloys. Albert Sauveur (*Trans. Amer. Soc. Metals*, 1934, 22, 97-113; discussion, 114-119).—See *J. Inst. Metals*, 1933, 53, 627.—S. G.

†**Thermal and Electrical Conductivities of Metals and Alloys.** J. W. Donaldson (*Metallurgia*, 1934, 10, 17-19).—In a review of recent work which has been carried out on the thermal and electrical properties of ferrous and non-ferrous alloys, consideration is given to the relationship between the two properties as expressed by the Lorenz law $K\sigma = T$ constant, where K = thermal conductivity, σ = electrical resistivity, and T = absolute temperature. In general, it is concluded that the law holds approximately for pure metals and for alloys such as steel and the alloys of copper and of aluminium, it also holds with a considerable degree of accuracy, but that it varies for cast iron. The practical application of such a relationship, if definitely established for metals and alloys, is also discussed.—J. W. D.

†**The Mechanism of Phase Transformations in Eutectoid Alloys.** G. Kurdjumow (*Physikal. Z. Sowjetunion*, 1933, 4, 488-500).—[In German.] Experimental work relating to phase transformations in various alloys, including steel, is critically reviewed. The significance of (1) transformations not involving the process of diffusion; (2) destruction of intermediate phases and (3) the direct production of phases of the solid solution is discussed. A bibliography of 34 references is appended.—J. S. G. T.

III.—STRUCTURE

(Metallography; Macrography; Crystal Structure.)

(Continued from pp. 298–301.)

***On Grain-Size and Grain-Growth.** M. A. Grossmann (*Trans. Amer. Soc. Steel Treat.*, 1933, 21, 1079–1104; discussion, 1105–1111).—The paper records observations of the manner in which grain-size develops in a carburizing test and, in particular, the relationship of the McQuaid-Ehn carburizing test (usually carried out at 925° C. for 8 hrs.) to the austenite grain-sizes which may develop at other temperatures or in other periods of time.—S. G.

The Mechanism of Crystal Growth. Wheeler P. Davey (*Trans. Amer. Soc. Steel Treat.*, 1933, 21, 965–996; discussion, 997–1001).—See *J. Inst. Metals*, 1933, 53, 628.—S. G.

***Slip-Bands and Twin-Like Structures in Crystals.** Constance F. Elam (*Nature*, 1934, 133, 723).—Slip bands agreeing with traces of {110} planes have been observed in the β constituent of brass. Twin-like structures are produced when slip occurs on two planes equally inclined to the axis (in a tensile test) in different parts of the same crystal. The structures persist when the crystal is repolished and re-etched.—E. S. H.

***Deformation Structure of a Drawn Brass Tube.** V. Montoro (*Met. italiana*, 1933, 25, 825–831; *Chem. Zentr.*, 1934, 105, 1, 2646).—The crystallite orientation in a drawn brass tube (copper 73.3, zinc 20, aluminium 6.7 atomic-%) has been determined during various stages of drawing. Most of the crystallites are oriented in the [111] direction, tangent plane (011); but a few are oriented in the [001] direction, tangent plane (100). The distribution of the crystallites in these groups and the tendency of the fibre axes to lie in the geometrical axis of the tube depend on the dimensions of the tube and the working conditions.—A. R. P.

***Multiple Laue Spots from Aluminium Crystals.** A. Komar and W. Obukhoff (*Nature*, 1934, 133, 687).—The distribution of intensity in Laue spots from thick (6 mm.) deformed aluminium crystals depends greatly on the degree of plastic deformation.—E. S. H.

***An X-Ray Study of the Gold-Iron Alloys [and Some Magnetic and Age-Hardening Properties].** Eric R. Jette, Willard L. Bruner, and Frank Foote (*Metals Technology*, 1934, (Jan.), 1–14, *A.I.M.M.E. Tech. Publ.* 526).—The gold-iron system has been investigated by X-ray analysis, and the lattice constants have been determined for specimens annealed and quenched from different temperatures. The system contains the two terminal solid solutions, and no intermediate phases or compounds. The solid solution in gold varies from about 3.5% of iron by weight at 300° C. to 17.2% at 724° C., so that age-hardening precipitation is to be expected, and was studied for an alloy containing 15% of iron. The solubility of gold in α -iron is small at low temperatures, and increases to about 2% of gold by weight at 700° C., but accurate photographs were not obtained. The homogeneous gold-rich alloys retain the diamagnetic properties of pure gold up to about 0.1% iron, when they become paramagnetic, whilst the 10% and 15% iron alloys are ferromagnetic when quenched from high temperatures, even though they still consist of the homogeneous solid solution in gold. In the iron-rich alloys the γ structure could not be retained by quenching.—W. H.-R.

***X-Ray Studies on [and Solid Solution Limits in] the Nickel-Chromium System.** Eric R. Jette, V. H. Nordstrom, Barnard Queneau, and Frank Foote (*Metals Technology*, 1934, (Jan.), 1–11, *A.I.M.M.E. Tech. Publ.* 522).—Nickel-chromium alloys were prepared from pure electrolytic metals, and X-ray powder photographs were taken after annealing and quenching from different temperatures up to 1150° C. The system consists of the two terminal solid

solutions with an intervening two-phase area, but no intermediate compounds were detected. The solubility of nickel in chromium is small at low temperature, but increases markedly at high temperatures to 8.4% nickel by weight at 1113° C. The solubility of chromium in nickel increases almost linearly with the temperature from about 32.4% chromium by weight at 524° C., to 52.2% at 1113° C. This last value is beyond the eutectic composition of the previously accepted equilibrium diagrams, but these are based on less pure materials. Some of the supposed nickel-chromium compounds reported in previous X-ray work are probably due to oxide and nitride contamination.—W. H. R.

***Crystal Orientations Developed by Progressive Cold-Rolling of an Alloyed Zinc Containing 1 Per Cent. of Copper, and 0.01 Per Cent. of Magnesium.** M. L. Fuller and Gerald Edmunds (*Metals Technology*, 1934, (Jan.), 1-8, *A.I.M.M.E. Tech. Publ.* 524).—Cast bars of the above alloy were rough rolled by the usual hot-rolling practice, and then annealed, cold-rolled with a total reduction of 50%, reannealed, and "finish-rolled" cold, with total reductions of 30, 50, and 80% to a final thickness of 0.04 in. The crystal orientation was investigated by the method previously used (F. and E., *Trans. A.I.M.M.E.*, 1932, 99, 75). The crystals deform, like those of pure zinc, by the gliding of blocks of the crystal parallel to the basal plane in a direction of closest packing of the lattice, and by twinning on planes of the form {102}. The two preferred orientations known for zinc were observed, and also a third type with the basal plane perpendicular to the rolling direction. In this last position crystals tend to remain fixed in orientation during rolling. This type of preferred orientation has not been reported for pure zinc, and this is probably because the pure metal recrystallizes during rolling much more readily than the alloy.—W. H. R.

***On the Binding Forces in the Alkali and Alkaline Earth Metals According to the Free Electron Theory.** O. K. Rice (*J. Chem. Physics*, 1933, 1, 649-655).—A full account of this work, previously published only in abstract (see *Met. Abs.*, this volume, p. 13).—S. G.

†**The X-Ray Investigation of Microstructure: Problems and Methods.** W. E. Schmid (*Arch. tech. Messen*, 1934, 3, (34), T48-T49).—A survey of current applications of the X-ray examination of crystal structure. These are summarized thus: general investigation of microstructure, measurement of grain-size, determining orientation, demonstrating the presence of elastic stresses and internal strain, comparison of different crystalline bodies, and hence estimation of effect of alloying ingredients, and determination of the atomic arrangement in the space-lattice. The fundamental principles of the process are stated, and the standard methods of Laue and of Debye-Scherrer and Hull are described, with some recent modifications.—P. M. C. R.

***Segregation of Polonium in Bismuth Crystal [Evidence for Secondary Structure in Crystals].** William W. Eaton (*Phys. Rev.*, 1934, [1], 45, 647-648).—The results of Focke (*Phys. Rev.*, 1934, 45, 219) are confirmed.—W. H. R.

IV.—CORROSION

(Continued from pp. 301-304.)

***Corrosion-Resistance of Structural Aluminium.** E. H. Dix, Jr. (*Proc. Amer. Soc. Test. Mat.*, 1933, 33, (II), 405-412; discussion, 413-415).—Since the mechanical testing of thin-sheet specimens as a means of evaluating the relative corrosion-resistance of metals does not afford satisfactory data for obtaining a true conception of the mechanical permanence of thick structural shapes, an extensive series of tests is being made on aluminium alloys by the Aluminium Research Laboratories, involving outdoor and accelerated corrosion exposures of full-sized structural shapes in comparison with sheet and plate specimens. The results up to the present on Duralumin 17 ST (copper 4-4.3,

manganese 0.6, magnesium 0.5, iron 0.5, and silicon 0.2–0.5%) indicate that the corrosion is "self-stopping," and therefore tensile tests made on thin specimens given an entirely misleading idea of the behaviour and stability of structural sections. Beam and column tests on full-size sections show no decrease in the load-supporting capacity of the alloy after exposure to severe corrosive conditions, which produced marked deterioration of the mechanical properties of thin sections. The depth of penetration of the corrosion appears to be independent of the thickness, and on sections of 0.2 in. and thicker the effect of corrosion on the mechanical properties is negligible. In the discussion further evidence of the stability of thick sections of Duralumin 17 ST under corrosive conditions was given by *L. B. Tuckerman* and by *H. S. Rawdon* and *W. H. Mutchler*.—A. R. P.

***Effect of Methyl Alcohol on Magnesium, Aluminium, and Their Alloys.** *J. Formánek* (*Automobiltech. Z.*, 1934, 37, 190–192).—The corrosive action of anhydrous methyl alcohol on certain light alloys is inhibited by water, but this renders the "methanol" unsuitable for use in benzene-ethyl-methyl alcohol mixtures. The effect of 3 grades of methyl alcohol was investigated on pure magnesium powder, commercial magnesium ribbon, 5 types of Elektron (analyses given), pure powdered aluminium, Lantal, Silumin, and Hydronalium. Additions of anhydrous ethyl alcohol, or its presence up to 50% in the mixture, inhibited corrosive attack; with more than 50% methyl alcohol certain materials are attacked, but this action is checked if 0.5% of acetone is added. Commercial "methanol," containing traces of sulphur, phosphorus, zinc, and arsenic, may cause severe attack.—P. M. C. R.

***Outdoor Test Results on Bare and Metal-Coated Ferrous Specimens.** *C. D. Hocker* (*Amer. Soc. Test. Mat. Preprint*, 1934, March, 1–19).—The time required for the development of the first rust spots on hot-dipped galvanized-iron sheets and the subsequent progressive rusting in several test localities is illustrated graphically. Similar graphs are given for hardware coated with zinc (by plating, by hot-dipping, and by Sherardizing), cadmium (by plating), aluminium and lead (by hot-dipping). Hot-dipped zinc coatings are superior to Sherardized and plated zinc coatings, which appear to be of equal merit except in the case of deeply recessed articles, where the plated deposit does not throw well. Plated cadmium deposits are inferior to zinc as a protection for steel. Hot-dipped aluminium coatings afford good protection to steel in all types of atmosphere; so far little difference has been detected in the behaviour of aluminium coatings (1.55 oz./ft.²) and hot-dipped zinc coatings (2.2 oz./ft.²). Lead coatings are on the whole unsatisfactory rust preventatives except in industrial atmospheres; pinholes are the chief cause of this unsatisfactory behaviour.—A. R. P.

***The Harmony of Outdoor Weathering Tests [Corrosion of Zinc and Cadmium-Coated Steel].** *R. F. Passano* (*Amer. Soc. Test. Mat. Preprint*, 1934, March 49–61).—Outdoor corrosion tests in 5 different types of atmosphere show that zinc coatings of a given weight last longer than cadmium coatings of equal weight, and that the amount of zinc coating required for a given amount of protection varies considerably with the type of atmosphere. The underside of galvanized sheets on test racks is fairly well protected by the zinc coating in all atmospheres, but zinc coatings afford little protection to steel when moisture is allowed to accumulate between the plates. This latter fact is of importance, in that it explains failures at laps in construction of corrugated galvanized iron.—A. R. P.

***Galvanic Corrosion by Contact of Dissimilar Metals.** *C. L. Hippensteel* (*Amer. Soc. Test. Mat. Preprint*, 1934, March, 39–48).—The corrosion of other metals in contact with them is accelerated by the following metals in the order given (most active metal first): nickel, tin, copper, iron, lead, aluminium. The common metals may be rated from best to worst according to their sus-

ceptibility to acceleration of corrosion by galvanic action as follows: nickel, copper, tin, lead, aluminium, iron. Data are given of the behaviour of couples of all the above metals in various types of atmosphere.—A. R. P.

***How Soon is it Safe to Draw Conclusions? (A Discussion of the Early Interpretation of Test Results in the Atmospheric Corrosion of Non-Ferrous Metals and Alloys.)** W. H. Finkeldey (*Amer. Soc. Test. Mat. Preprint*, 1934, March, 20-38).—An analysis is given of the data collected by a sub-committee of the A.S.T.M. which has been making atmospheric corrosion tests on 24 non-ferrous metals and alloys in 9 different atmospheres, and the difficulties encountered in interpreting the data are discussed. The results so far obtained show that the initial rate of corrosion of most non-ferrous metals and alloys, whether measured by loss in weight or a loss in tensile strength or ductility, decreases after exposure for 1-2 years, and the time required to reach a more or less normal rate of corrosion varies with the metal or alloy and with the type of atmosphere. Size and shape of materials and variations in the tensile strength and ductility of the different parts of the specimen are of importance in interpreting the results. A critical examination of the data so far obtained leads to the following conclusions. In industrial atmospheres the greatest resistance to corrosion is shown by antimonial lead, chemical lead, pure tin, copper-rich alloys, commercial copper, commercial aluminium, and a 1% manganese-aluminium alloy, and least resistance by nickel, zinc, Duralumin, and a 1:0.6 silicon-magnesium-aluminium alloy. Manganese-bronze, 70:30 brass, and 70:30 nickel-copper alloy are less resistant to industrial atmospheres than commercial copper. In marine atmospheres nickel and nickel-copper alloys, chemical lead and antimonial lead show the greatest resistance to corrosion, and zinc, tin, and Duralumin the least; high-copper alloys and commercial copper are less resistant than nickel-copper alloys, and aluminium alloys in general show a low resistance to corrosion in marine atmospheres except aluminium-coated Duralumin. Corrosion of all the non-ferrous alloys tested in rural atmospheres is very slight.—A. R. P.

Corrosion by Sea and Ozone. Anon. (*Met. Ind. (Lond.)*, 1934, 44, 300).—Briefly describes the work of the Mersea Island Testing Station.—J. H. W.

The Use of Bureau of Standards Soil Corrosion Data in the Design and Protection of Pipe-Lines. K. H. Logan (*Amer. Soc. Test. Mat. Preprint*, 1934, June, 1-15).—In 1922 the U.S. Bureau of Standards undertook to determine whether serious corrosion could occur underground in the absence of stray electric currents. The existence of such corrosion is demonstrated by the data, but the solution of the problem of economically reducing the corrosion is incomplete. Soils rather than materials control the corrosion of existing pipe-lines. The Bureau of Standards data on the corrosiveness of soils must be modified by coefficients or factors which take account of conditions not represented in the Bureau tests. Further work is required to determine the significance of certain tendencies shown by the data; notably, the effects of the size and age of the specimen on which pit measurements are made, the protective effects of corrosion products, and the results of departure from homogeneity of the soil with respect to its physical characteristics. An economic solution of the problem of protecting pipes against corrosion cannot be found until numerical values can be assigned for the life of unprotected pipes and the life extension to be expected as the result of the use of a protective coating. Ideas as to the necessary qualities of a satisfactory coating have been developed, but there are no satisfactory ways of measuring these qualities or of determining the amounts of each property which are necessary.—S. G.

†**Report on Bureau of Standards Soil Corrosion and Pipe Coating Investigation.** Leonard P. Wood (*J. Amer. Water Works Assoc.*, 1934, 26, 176-188).—A review, with some individual comments, of the scope, progress, and results of

the soil corrosion investigation of the U.S. Bureau of Standards (cf. *Met. Abs.*, this volume, p. 242).—J. C. C.

The Corrosion of Metal Pipes by Stray Currents in the Soil. Anon. (*Bull. tech. Suisse Romande*, 1934, 60, 117–118).—A brief criticism and correlation of work published by O. Scarpa (*Energia elettrica*, 1934, Jan.), and by R. Gilrat (*Rev. gén. Élect.*, 1934, Feb. 17 and 24).—P. M. C. R.

Field Tests on Corrosion. J. C. Hudson (*Met. Ind. (Lond.)*, 1934, 44, 415–418, 441; discussion, 441–443).—Read before the Midland Metallurgical Societies (Birmingham Local Section of the Institute of Metals, Birmingham Metallurgical Society, and Staffordshire Iron and Steel Institute). The field tests carried out by more or less national organizations in Germany, America, Sweden, and Holland are briefly described, and a fuller account of the work being done in this country is given.—J. H. W.

The Usefulness of Corrosion Tests to the Chemical Engineer. A. S. White (*Indust. Chemist*, 1934, 10, 98–101).—A general discussion.—E. S. H.

The Assessment of Corrosion Damage. A. S. White (*Indust. Chemist*, 1934, 10, 170–172).—W. considers the relative effects of (a) general and uniform surface attacks; (b) pitting; and (c) intergranular attack.—E. S. H.

V.—PROTECTION

(Other than Electrodeposition.)

(Continued from pp. 304–306.)

The Fight Against Corrosion. L. Labiesse (*Arts et Métiers*, 1934, 87, 74–83).—The methods of protecting iron and steel from corrosive attack are summarized, and include coating the base metal with aluminium, zinc, tin, lead, cadmium, nickel, and chromium, by immersion, spraying, cementation, and electrolysis.—J. H. W.

Surface Protection of Metals. Leonard F. Hirsh (*Machinist (Eur. Edn.)*, 1934, 78, 252–253E).—The methods of application and the advantages and limitations of the 6 more commonly used rust-proofing processes, namely, hot galvanizing, Sherardizing, zinc, and cadmium plating, Parkerizing, and Bonderizing, are described.—J. H. W.

The Protection and Decoration of Aluminium and Its Alloys by Anodic Treatment. S. Wernick (*Indust. Chemist*, 1934, 10, 179–183).—A review, covering methods of production of the film, theory of its formation, and method of detaching it.—E. S. H.

Is the Tinning of Copper Efficacious? Anon. (*Illust. Z. Blechindustrie*, 1934, 63, 563–564).—From a report of the Preussische Landesanstalt für Wasser-, Boden- u. Lufthygiene. The practicability of tinning is influenced both by working conditions and by method. Galvanization, although so far of limited application, has given good results; wiping or dipping, unless lead is present, tends to give a brittle and porous coating, and on hygienic grounds the presence of lead is inadmissible for certain purposes, besides increasing the liability to corrosion. The progressive corrosion of tinned objects is described, with emphasis on the action of certain accelerating agents, the presence of which in water renders tinning ineffective.—P. M. C. R.

A New Zinc-Coating Process. J. L. Schueler (*Wire and Wire Products*, 1934, 9, 139–141).—In the "Flame-Sealed" zinc-coating process, steel wire passes through an annealing furnace, is cooled, cleaned in hydrochloric acid and a fluxing solution, dried and passed through a bath of molten zinc. Thence it passes to a coating regulator, in which the amount of zinc to be carried by the wire is regulated mechanically. Finally, it passes through a flame-sealing unit where the coating is consolidated.—J. H. W.

†**The Present Position of Galvanizing Technique and Galvanizing as a Protection Against Rusting.** Hans M. Forstner (*Oberflächentechnik*, 1934, 11, 51-53, 65-67, 75-79, 89-92).—Modern methods of coating ferrous metals with zinc are described and the properties of the coatings obtained by the various processes are critically discussed, with especial reference to their protective value against rusting.—A. R. P.

Behaviour of Sprayed Metal Coatings Towards Liquids and Gases. H. Reininger (*Metallwaren-Ind. u. Galvano-Tech.*, 1934, 32, 235-236).—Vessels with sprayed protective coatings should not be used for boiling liquids, since liquid enters the pores and there vaporizes, with the production of a high pressure, which tears the coating away from the base metal. Sprayed zinc coatings, although porous, afford adequate protection for iron and steel articles against weathering, since the pores gradually become filled with zinc oxide and carbonate, which form an impervious cement binding the network of zinc together.—A. R. P.

Metallization by Projection. Anon. (*Galvano*, 1934, (23), 28-29, (24), 27-28).—A review.—E. S. H.

New Process Employs Alternating Current to Rustproof Metal Parts [Granodizing]. Anon. (*Automotive Ind.*, 1934, 70, 405).—The Granodizing protective process, primarily intended for steel sheet, can be modified to provide a resistant foundation for the reception of paint on zinc-base die-castings or cadmium plating. The chemically cleaned pieces are immersed in Granodine, a proprietary preparation, and exposed to a controlled a. c. for a period varying with the type of surface. A smooth, continuous, and insoluble deposit of tin-zinc phosphate is said to result.—P. M. C. R.

Difficulties in Painting Copper with Oil Colours. Fritz-Jürgen Peters (*Korrosion u. Metallschutz*, 1934, 10, 91-93).—Oil colours dry very slowly and irregularly on copper, drying generally starting from more or less oxidized places and spreading outwards so that the dried paint film has a patchy appearance. Drying proceeds normally, however, on a uniformly oxidized copper surface, but this is difficult to obtain in practice, hence it is recommended to apply a lacquer film as a priming coat, since paint films dry normally on this.—A. R. P.

Protective Coatings for Metal Work. E. A. Hurst (*Indust. Finishing (U.S.A.)*, 1934, 10, (4), 16-22).—A review, confined to paint coatings.—E. S. H.

VI.—ELECTRODEPOSITION

(Continued from pp. 307-309.)

Cadmium Plating of Iron and Steel Parts. Werner Fröhlich (*Metallbörse*, 1933, 23, 1537-1538).—Most of the faults found in cadmium-plated ferrous articles are attributable to incorrect preparation; practical hints are given for cleaning the articles and for operating various types of plating bath.

—A. R. P.

On Chromium Plating. Max Schlötter (*Oberflächentechnik*, 1934, 11, 40-41).—The use of an intermediate nickel layer not less than 0.02 mm. thick is recommended in all cases where an outer chromium plate is to be applied, even when brass or copper is the base metal. The nickel should be deposited under such conditions that it is practically free from adsorbed hydrogen; it then acts as an adsorbent for the hydrogen generated during chromium plating, which otherwise would form a gas layer between the base metal and the chromium, and thereby impart a tendency to flake to the chromium plate.

—A. R. P.

Theory of Chromium Plating. Erich Müller (*Z. Elektrochem.*, 1934, 40, 326-337).—E. Liebreich's theory of chromium plating (see *Met. Abs.*, this

volume, p. 184) is discussed and criticized and M.'s own theory is further elucidated. Cf. *J. Inst. Metals*, 1932, 50, 370 *et ante*.—J. H. W.

The Reduction of Mist or Spray from Chromium Baths by Fixed Oils such as Fish Oil. C. M. Alter and F. C. Mathers (*Monthly Rev. Amer. Electroplaters' Soc.*, 1934, 20, (9), 11–16).—Spray loss from chromium-plating baths can be reduced or almost entirely eliminated by covering the surface with a thin film of oil which forms a layer of foam; such oils are fish oil, whale oil, sperm oil, olive oil, castor oil, and lanoline. About one drop of oil per in.² of surface is sufficient, but a few drops should be added occasionally to keep the foam layer intact. The oil does not affect the plating results in any way, and is not oxidized by the bath.—A. R. P.

***The Electrodeposition of Nickel from Solutions of More than p_H 7.0.** Marcel Ballay (*Compt. rend.*, 1934, 44, 1494–1496).—Good deposits have been obtained by specially buffered solutions with p_H values between 3.5 and 10.0, with a current density up to 10 amp./dm.². The concentration of nickel in sulphate solutions is limited by the low solubility of the double nickel-ammonium sulphate. The addition of citric acid and its alkali salts prevents precipitation of nickel hydroxide. For concentrations of nickel of from 20.8 to 45 gm./litre, the minimum concentration of citrates must be such that the ratio of the atomic concentration of nickel to the molecular concentration of citrate is about 2. Glycollic and lactic acids and sodium lactate act in a similar manner. Malic and tartaric acids, glucose, maltose, and glycerine do not prevent precipitation of nickel hydroxide in the solutions studied. The following solution was particularly studied: nickel 20.8, NH₃ 6.3, Cl 6.0, neutral crystalline sodium citrate 150 gm./litre at 40° C., with current density from 2 to 10 amp./dm.² and p_H varying from 3.6 to 9.8. In the alkaline zone, the deposits are very fragile. With $p_H = 5.0, 7.0, \text{ and } 9.6$, the respective cathodic efficiencies were 59.2, 90.0, and 94.2%, the anodic efficiency falling from 100% at $p_H = 5.0$ –7.0 to 88% at 9.6. In the absence of citrate, a solution containing 20.8 gm./litre of nickel had a cathodic efficiency of about 82% at 50° C., and a current density of 1.1 amp./dm.². The nickel did not appear to be monovalent in this state as had been believed.—J. H. W.

Impurities of Nickel Solutions with Reference to Pitting of Electrodeposited Nickel. F. J. Liscomb (*Monthly Rev. Amer. Electroplaters' Soc.*, 1933, 20, (4), 6–10; discussion, 10–15).—One of the chief causes of pitting in nickel plate is the presence in the solution of organic matter; this may be removed by the following treatment: the p_H is raised to 6.3 by addition of nickel carbonate, caustic soda, or ammonia, the bath is heated to 50°–65° C., and to every 100 gall. is added a solution of 12 oz. of ferrous sulphate crystals, followed by 33 oz. of 5% hydrogen peroxide, and, after standing over-night, the mud containing the organic matter and ferric hydroxide is filtered off. The p_H is then adjusted to 5.4–5.6 by addition of dilute H₂SO₄.—A. R. P.

On the Nickel Plating of Sheet Aluminium Articles. Robert J. Snelling (*Metalware-Ind. u. Galvano-Tech.*, 1934, 32, 23–29).—The articles are polished and cleaned mechanically, then chemically cleaned by immersion for 1½ minutes at 95° C. in a solution containing borax 15, sodium carbonate 7.5, sodium hydroxide 2, ammonium chloride 2, and soap 4 gm./litre. After thorough washing, they are immersed in 1:4-hydrochloric acid containing cadmium chloride 18 and ammonium fluoride 4 gm./litre, again washed, and brass-plated in a cyanide solution. A final nickel coating of any desired thickness can then be applied in any of the usual high p_H nickel baths containing boric acid. Other preparatory methods are also described and briefly discussed.—A. R. P.

Nickel Plating Aluminium. M. Ballay (*Rev. Aluminium*, 1934, 11, 2365–2370).—The history of the nickel plating of aluminium is briefly reviewed. Practical details for carrying out this process are given, and include degreasing,

compositions of baths for preparing the surface and for the nickel-plating operation itself and for chromium plating on the nickel plate. The properties of the nickel coat and methods of testing it are described, and notes and criticisms of methods employed in special cases are given.—J. H. W.

On the Nickel Plating of Aluminium. W. Fröhlich (*Metallbörse*, 1934, 24, 405-406, 439, 469-470).—Notes on the preparation of the metal and on the composition and operation of suitable nickel plating baths.—A. R. P.

Splitting of Nickel-Plated Brass Articles and Its Cause and Prevention. H. Reininger (*Metallwaren-Ind. u. Galvano-Tech.*, 1934, 32, 143-144, 163-165, 211-213).—The splitting (season-cracking) of nickel-plated brass articles is attributed to the use of unsuitable brass and the presence of high internal stresses combined with the notch effect of ruffles introduced by deep-drawing, of scratches produced in polishing, of non-metallic particles of abrasive forced into the metal, and of hydrogen absorption in plating. Intercrystalline corrosion produced by inclusion of electrolyte in unsound parts is also a fruitful cause of failure of the metal. To avoid these troubles the brass used should be practically pure α , it should be annealed dead soft prior to deep-drawing and spinning; if severely cold-worked during fabrication it should be given a relief-anneal, and all irregularities introduced during working should be thoroughly polished out before plating.—A. R. P.

Factors Contributing Toward Quality of Plated Zinc Die-Castings. Carl Hussner (*Monthly Rev. Amer. Electroplaters' Soc.*, 1933, 20, (4), 15-20; discussion, 20-23).—Practical hints are given for preparing the castings for plating and for obtaining good nickel deposits. Copper or brass undercoats are deemed unnecessary.—A. R. P.

Action of Buffers on Electrolytic Metallic Deposits. J. Salauze (*Bull. Soc. franç. Élect.*, 1934, [v], 4, 473-490; discussion, 491-492).—The action of a buffering agent may be purely mechanical, molecules of the material becoming adsorbed on the cathode. The composition of the liquid cathodic film may be modified either by a diminution of p_{H} value by reaction with the cathode, or by the formation of a protective viscous screen round it. Certain buffering agents may give rise to colloidal metal which becomes incorporated in the deposit and profoundly modifies its character. Others form substances which are mechanically included in the deposits and which may thus cause brittleness. Fuseya's observations on the discharge of complex ions at the cathode, with consequent refinement of the deposit, are summarized. The effect of ageing is considered, and lines for further investigation are suggested. A bibliography is given.—P. M. C. R.

Selenium Rectifiers for Plating Plant. Karl Maier (*Metallwaren-Ind. u. Galvano-Tech.*, 1934, 32, 67-68).—The use and operation of the selenium rectifier is described with reference to wiring diagrams.—A. R. P.

Health Protection in Plating Plants. R. J. Piersol (*Metal Cleaning and Finishing*, 1934, 6, 25-29; *C. Abs.*, 1934, 28, 2625).—A detailed description of methods employed in plating plant to guard against health hazards.—S. G.

VII.—ELECTROMETALLURGY AND ELECTROCHEMISTRY

(Other than Electrodeposition and Electro-Refining.)

(Continued from pp. 309-310.)

Electro-Metallurgical Progress in 1933. S. Wernick (*Indust. Chemist*, 1934, 10, 13-14).—A review, with special reference to deposition from molten electrolytes and aqueous solutions of organic and inorganic salts. Notes are given on the deposition of nickel, chromium, cadmium, platinum, palladium, and rhodium.—E. S. H.

***Development and Use of Anaconda Electro-Sheet Copper.** William M. Shakespeare (*Trans. Amer. Inst. Min. Met. Eng.*, 1933, **106**, 441-448).—Copper sheet weighing upwards of 1 oz. per ft.² is produced in large quantities directly from anode copper at the Raritan Copper Works. In the first stage the cathode consists of a lead-covered copper drum rotating half-immersed in a solution of copper sulphate and sulphuric acid, a lead anode being spaced $\frac{1}{2}$ in. from the whole of the immersed surface of the drum so that the vigorous oxygen evolution keeps the electrolyte well agitated; the deposited sheet (0.00135 in. thick) is continuously removed from the topmost point of the drum and wound in rolls. The sheet on these rolls is then built up to any desired thickness by passing it continuously in a series of loops suspended between vertical copper electrodes spaced regularly through a long tank. Operating details of both sections of the plant are given, together with a brief account of the difficulties met with in developing the process. Sheet copper produced by the process is finding an extending use in making roofing shingles and flashings, for making automobile tops, for making plywood compositions, and even in bookbinding and the manufacture of fancy boxes.—A. R. P.

VIII.—REFINING

(Including Electro-Refining.)

(Continued from pp. 249-250.)

***Removal of Arsenic and Antimony from Copper by Furnace-Refining Methods.** W. J. Hillebrand, R. K. Poull, and H. C. Kenny (*Trans. Amer. Inst. Min. Met. Eng.*, 1933, **106**, 483-486).—Arsenic and antimony can be practically entirely removed from copper by blowing the molten metal with air until it contains about 1% of oxygen, then blowing powdered sodium carbonate through the metal to dissolve the oxidized antimony and arsenic compounds. In this way elimination of these impurities is rapid, and the slag can be removed before it has an opportunity to attack the lining of the furnace.—A. R. P.

Notes on the Purification of Electrolytes in Copper Refining. E. S. Bardwell and R. J. Lapee (*Trans. Amer. Inst. Min. Met. Eng.*, 1933, **106**, 417-426; discussion, 426).—For abstract of the paper see *Met. Abs.*, this volume, p. 190. In the discussion O. Nielsen recommends the use of a soft-iron pan over an open fire for evaporating acid sulphate electrolytes. No action on the pan occurs when the density of the solution exceeds 1.4 and evaporation can be continued to *d* 1.6; the liquor is removed from the pan, the suspended anhydrous sulphates are allowed to settle, and the strong acid liquor is returned to the pan and diluted down to *d* 1.4 by addition of fresh electrolyte.—A. R. P.

IX.—ANALYSIS

(Continued from pp. 310-311.)

The Development of Analytical Chemistry. P. F. Thompson (*Chem. Eng. Min. Rev.*, 1934, **26**, 213-217).—The history of chemical science and the testing of metals and modern chemical methods is briefly traced from the earliest times to the end of the last century.—J. H. W.

Metallurgical Spectrum Analysis. Welton J. Crook (*Trans. Amer. Soc. Steel Treat.*, 1933, **21**, 708-732).—C. describes the construction and use of a 21-ft. focal length grating spectrograph as applied to metallurgical analysis. A new method of reading is described in which the spectrum film is placed in an enlarger and projected on to visual charts. The readings are made at a magnification such that 1A. = 5 mm. In this way the tedious method of using a micro-comparator is obviated.—S. G.

***A Contribution to Quantitative Optical Spectroanalysis.** W. Seith and E. Hofer (*Z. Elektrochem.*, 1934, 40, 313-322).—Tables have been drawn up for the quantitative optical spectroanalysis, by the method of homologous conjugate lines due to Gerlach and Schweitzer, for the detection and estimation of Ni in Pb, Pb in Sn, Mg in Pb, and Ca in Pb. This method cannot be used for the detection of Cu in Pb, Pb in Cd, or Cd in Pb, and another method has been worked out for these cases, depending on the comparison of the darkening of certain lines of both the constituents of the alloys by means of a photometer. This method gives reproducible results.—J. H. W.

A New Analytical Method for the Metal Industry. Julius Grant (*Met. Ind. (Lond.)*, 1934, 44, 459-460).—A discussion is given of nephelometry, the methods of measuring and comparing turbidity, including the use of photo-electric cells, and the applications of the method for the estimation of zinc, silver, calcium, mercury, aluminium, phosphorus, arsenic, lead, and magnesium.

—J. H. W.

***Analysis of Silver Baths: A Method of Determining the Potassium Formate Content of Old Silver Plating Baths.** Curt Lochmann (*Metallwaren-Ind. u. Galvano-Tech.*, 1934, 32, 188).—Since potassium formate is formed by hydrolysis of cyanide in old silver plating baths and its presence necessitates the use of a smaller amount of free cyanide than usual, the following procedure for its determination has been worked out: the solution (10 c.c.) is acidified with H_2SO_4 , the $AgCN$ filtered off, and the filtrate neutralized with $NaHCO_3$, treated with a rapid current of CO_2 for 4 hrs. to expel HCN , again acidified with H_2SO_4 and distilled to expel $HCOOH$, which is collected in dilute $NaOH$ solution. The resulting $NaCHO_2$ is oxidized to carbonate by warming with excess (T_1 c.c.) of 0.1N-permanganate, the solution is acidified with H_2SO_4 and warmed with 0.1N-oxalic acid (t c.c.) to destroy the MnO_2 , &c., and the excess of oxalic acid (T_2 c.c.) is determined by titration with permanganate; then $0.34(T_1 + T_2 - t) = \text{gram. of potassium formate per litre of bath.}$ —A. R. P.

***On a New Colour Reaction for Cobalt.** Eduardo F. Brau (*Rev. Fac. Cienc. quim. La Plata*, 1933, 6, 65-70; *Chem. Zentr.*, 1934, 105, I, 2797).—In the presence of $CH_3 \cdot COONa$ Co gives an intense orange-red to red colour with a mixture of dimethylglyoxime and one of the following: benzidine, tolidine, dianisidine, 2:7-diaminodibenzofurane, 2:7-diaminofluorene.—A. R. P.

Detection and Microdetermination of Silver, Mercury, and Iodides. I. M. Korenmann (*Mikrochemie*, 1934, 14, 181-188).—The solution is titrated with 0.01N-KI containing a small amount of I_2 and starch until the blue colour disappears.—A. R. P.

***Method of Separating Antimony and Tin.** M. Raymond (*Compt. rend.*, 1934, 198, 1609-1611).—Sn can be separated from Sb in alkaline solutions containing triethanolamine, $N(CH_2 \cdot CH_2 \cdot OH)_3$. The freshly precipitated hydroxides are readily soluble in the reagent, but become insoluble on keeping or heating. Solutions containing Sn^{IV} salts are easily decomposed by weak acids (CO_2 , H_2S) or by alkali or NH_4 salts (chlorides, sulphates, or carbonates), whereas Sb^{III} or Sb^V solutions are much more stable; this behaviour enables a separation of the metals to be made provided that the $Sn(OH)_4$, which first separates as a colloid and thus adsorbs Sb, is reprecipitated. The HCl solution of the metals is oxidized with Br, and a large excess of NH_4HCO_3 solution added, followed by a small excess of 20% ethanolamine solution; the hydroxides first precipitated redissolve on warming, but later the $Sn(OH)_4$ separates and is flocculated after heating for 1 hour on the water-bath. The precipitate is washed with 10% $(NH_4)_2CO_3$ solution, redissolved in HCl, reprecipitated as before, and ignited to SnO_2 . The filtrate is acidified with $CH_3 \cdot CO_2H$, and treated with H_2S , the Sb_2S_3 being heated at $280^\circ C.$ in CO_2 for weighing.—J. H. W.

***A Separation Reaction for Mercury.** M. Stschigol (*Z. anal. Chem.*, 1934, **96**, 328-330).—The solution is treated with an equal volume of 10% KI solution, a large excess of 30% NaOH solution is added, and the Hg precipitated by boiling with 1 c.c. of glycerol.—A. R. P.

***Estimation of Small Amounts of Bismuth, Antimony, Tin, and Molybdenum in Copper.** Bartholow Park (*Indust. and Eng. Chem. (Analyt. Edn.)*, 1934, **6**, 189-190).—Bi, Sb, Sn, and Mo are quantitatively separated from Cu by boiling the neutral nitrate solution of the metal (100 gm. of Cu evaporated to dryness with 400 c.c. of HNO₃ and the solution of the residue neutralized with Na₂CO₃) with 10 c.c. of 20% KBr solution and 10 c.c. of 3% KMnO₄ solution until Br ceases to be evolved. The precipitate is collected, washed, and dissolved in HCl, the solution treated with H₂S, the sulphides dissolved in HNO₃ and HCl, and the solution evaporated to 5 c.c. and tested spectrographically against standards prepared similarly, using graphite electrodes with an arc discharge.—A. R. P.

***A New Volumetric Determination of Cobalt.** G. Spacu and M. Kuraš (*Bul. Soc. Stiințe Cluj*, 1934, **7**, 377-383; *Chem. Zentr.*, 1934, **105**, I, 2797).—The Co is precipitated with C₅H₅N and 0.1N-NH₄CNS as the complex Co(C₅H₅N)₄(CNS)₂ and the excess NH₄CNS is titrated with 0.1N-AgNO₃.—A. R. P.

***Rapid Determination of Copper in White Metals by Direct Precipitation in the Presence of Tin, Antimony, Lead, &c.** E. Azzarello and A. Accardo (*Ann. chim. applicata*, 1933, **23**, 483-490; *Chem. Zentr.*, 1934, **105**, I, 2626).—The alloy is dissolved in *aqua regia*, the solution treated with tartaric acid and an excess of NaOH, boiled, cooled, and filtered, and an aliquot part of the filtrate is made just acid with HCl and treated with a 1% solution of salicylaldoxime to precipitate the Cu. The Cu compound is collected on a glass filter, washed, dried *in vacuo*, and weighed; it contains 18.95% Cu.—A. R. P.

***A New Colorimetric Method for the Determination of Lead.** S. Feinberg (*Z. anal. Chem.*, 1934, **96**, 415-518).—The Pb is precipitated as PbMoO₄ and the Mo determined colorimetrically with KCNS and SnCl₂ in the usual way.—A. R. P.

***On the Determination of Lead as Carbonate and Its Separation from Silver by Means of Carbonic Acid in Dilute Pyridine Solution.** A. Jilek and J. Kota (*Coll. Trav. Chim. Tchécoslov.*, 1933, **5**, 396-409).—The solution containing not more than 0.2 gm. of lead or silver is diluted to 80 c.c., and 5 c.c. of C₂H₅OH are added, followed by 10% C₅H₅N solution until neutral to methyl orange; after 5-20 minutes, when a slight turbidity develops, a further 15 c.c. of C₅H₅N (10%) are added, and the solution is treated with a stream of CO₂ for 45 minutes. The precipitate of PbCO₃ is collected in a Gooch crucible, washed with dilute C₂H₅OH containing C₅H₅N and saturated with CO₂, dried at 120° C., and weighed.—A. R. P.

***A Rapid Semi-Micro-Method for the Gravimetric Determination of Magnesium as MgNH₄PO₄·6H₂O or as MgNH₄AsO₄·6H₂O.** L. W. Winkler (*Z. anal. Chem.*, 1934, **96**, 241-245).—The solution (20 c.c.) is treated with 0.5 gm. of NH₄Cl and heated just to boiling, 1 c.c. of 20% NH₄OH and 2 c.c. of 10% Na₂HPO₄ solution are added, and the mixture is stirred until the flocculent precipitate crystallizes (5 minutes). The precipitate is collected, washed with dilute NH₄OH, then with C₂H₅OH, dried *in vacuo*, and weighed as NH₄PO₄·6H₂O. The As compound can be produced similarly.—A. R. P.

***A Gravimetric Method for the Determination of Magnesium as MgNH₄AsO₄·6H₂O.** J. Dick and A. Rudner (*Z. anal. Chem.*, 1934, **96**, 245-248).—The solution is treated with 3-5 gm. of NH₄Cl, 1 gm. of (NH₄)₂HAsO₄, and HCl until clear; 2.5% NH₄OH is then added drop by drop to the cold solution with stirring until just alkaline to phenolphthalein, followed by $\frac{1}{3}$ rd the total volume of strong NH₄OH. After 1-1½ hrs. the precipitate is collected on a porous filter, washed with 2.5% NH₄OH, then with 95% C₂H₅OH, dried *in vacuo*, and weighed as MgNH₄AsO₄·6H₂O.—A. R. P.

***Rapid Determination of Small Amounts of Magnesium in Presence of Phosphates.** F. Thompson (*Indust. Chemist*, 1934, 10, 142).—The determination is based on the formation of a lake by Mg with turmeric in presence of NaOH, followed by colorimetric comparison with standards. Although the presence of phosphates affects the colour, interference due to this cause is eliminated by dissolving $\text{Ca}_3(\text{PO}_4)_2$ in the colour standard. The suspensions of lake may be made more stable by adding starch glycerite solution. A method for removing Fe is given.—E. S. H.

***A New Method for the Volumetric Determination of Mercury.** M. Stschigol (*Z. anal. Chem.*, 1934, 96, 330-333).—The Hg is precipitated as described in *Z. anal. Chem.*, 1934, 96, 328-330; *Met. Abs.*, this volume, p. 357, and the washed precipitate dissolved in HNO_3 and KMnO_4 to give $\text{Hg}(\text{NO}_3)_2$. The excess of KMnO_4 is just destroyed by cautious addition of FeSO_4 , and the Hg titrated with 0.1N- NH_4CNS (1 c.c. = 0.01003 gm. of Hg).—A. R. P.

An Indirect Method for the Potentiometric Determination of Nickel. G. Spacu and P. Spacu (*Z. anal. Chem.*, 1934, 96, 270-273).—The Ni is precipitated as $\text{Ni}(\text{C}_5\text{H}_5\text{N})_4(\text{CSN})_2$ and the excess of KCNS titrated potentiometrically with AgNO_3 after acidifying the filtrate with HNO_3 .—A. R. P.

Detection and Estimation of Small Amounts of the Platinum Metals. H. Wolbling (*Ber. deut. chem. Ges.*, 1934, [B], 67, 773-776).—Colour reactions are described for the recognition and estimation of the platinum metals in the presence of each other, in quantities of, if necessary, less than 1 mg., the methods including certain modifications of the thiourea and stannous chloride reactions. A scheme is given for the separation of the entire group, and a note is appended on the isolation of small amounts of these metals from dilute solution, and on the behaviour of the group on precipitation with ammonia.—P. M. C. R.

X.—LABORATORY APPARATUS, INSTRUMENTS, &c.

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

(Continued from pp. 311-312.)

On the Design and Construction of a Precision High-Power Metallographic Apparatus. Francis F. Lucas (*Trans. Amer. Soc. Steel Treat.*, 1933, 21, 1112-1134; discussion, 1134-1135).—A new metallographic apparatus of advanced design is described. It was planned to make this microscope as perfect mechanically as possible and to incorporate in its design the most efficient optical systems that could be devised. Its resolving power is of the highest order with visible light. Crisp, bright images are secured at magnifications of $\times 4000$ and $\times 6000$. The specimen may be illuminated with monochromatic light, a narrow band or a broad filtered band of light from any region of the visible spectrum.—S. G.

A New Optical Dilatometer. F. Bollenrath (*Light Metals Research*, 1934, 2, (48), 1-10).—Translated from *Z. Metallkunde*, 1934, 26, 62-65. See *Met. Abs.*, this volume, p. 311.—J. C. C.

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

(Continued from pp. 312-313.)

Non-Destructive Tests. E. C. Rollason (*Metallurgia*, 1934, 10, 9-12).—Non-destructive methods of testing, valuable as investigatory tests for improvements in the design or method of manufacture of an article, or for testing the quality or soundness of an article without damage, are discussed. Such tests include magnetic tests either by means of oscillographic records or by the magnetic dust methods; electromagnetic tests; acoustic tests; the use of the X-rays either by the Debye-Scherrer method or by radiography; and the

γ -ray method of examination. Each of the test methods referred to is described in brief detail and is illustrated diagrammatically.—J. W. D.

Methods of Testing in the Supervision of the Manufacture and Properties of Die-Castings. R. Schulze (*T.Z. prakt. Metallbearbeitung*, 1933, 43, 322–324).—A summary of desirable properties of alloys to be used for die-casting, of works tests, of laboratory inspection, and of the making of physico-mechanical examinations. To these are added microscopical investigation and trials of corrosion-resisting properties. The summary is useful and concise.

—W. A. C. N.

†**Testing of Stamping Materials.** H. D. Brasch (*T.Z. prakt. Metallbearbeitung*, 1933, 43, 317–321).—A review of the methods which are available for the testing of sheet metals that are to be used for stamping or deep-drawing. The processes are compared with regard to their utility.—W. A. C. N.

†**Present Knowledge of Testing by Machining.** Anon. (*T.Z. prakt. Metallbearbeitung*, 1933, 43, 303–305).—A review of the development of testing materials and tools by critical examination of machining processes employed on those materials. Such methods embrace the measurement of the increase in temperature due to the dissipation of heat during working and the determination of the lives of standard tools used in machining alloys under standard conditions. A relationship has been determined between the rate of cutting and the Brinell hardness.—W. A. C. N.

†**Reliable Work's Methods for Testing and Comparing the Cutting Durability of Tools and the Machining Properties of Engineering Materials.** H. Schallbroch (*T.Z. prakt. Metallbearbeitung*, 1933, 43, 305–311).—A preliminary discussion of the serviceability of machine tools and the resistance of engineering alloys to their action. These two factors are not necessarily dependent one on the other. In all machining processes the four fundamental factors are (1) the cutting time for a tool with normal life should be as long as possible; (2) the form of the alloy and the surface should be as favourable as possible; (3) the power required to induce cutting and the energy absorbed should be as small as possible; (4) the development of stress should be a minimum. The development of testing methods, bearing these factors in mind, is reviewed, and instruments designed to carry out these tests are illustrated and described.

—W. A. C. N.

†**Testing of Hot-Worked Engineering Materials.** M. Moser (*T.Z. prakt. Metallbearbeitung*, 1933, 43, 312–316).—Test results on materials formed hot, and not the result of machining, are affected considerably by the method of working and the orientation of the test-piece. The underlying reasons for this are the irregular solidification causing differences in chemical composition, and the creation of non-uniform stresses within the body. An attempt is made to reconcile the results obtained.—W. A. C. N.

***Studies on a Modification of the Rohn Test for Investigating Creep of Metals.** C. R. Austin and J. R. Gier (*Proc. Amer. Soc. Test. Mat.*, 1933, 33, (II), 293–307; discussion, 308–314; also abstract *Found. Trade J.*, 1934, 50, 213).—For abstract of the paper see *J. Inst. Metals*, 1933, 53, 519. The discussion, in which G. M. Eaton, H. W. Gillett, H. J. Gough, E. E. Thum, and C. R. A., took part deals with the interpretation of the results obtained by the Rohn test and with the effect of possible changes which occur in the structure of the metal during the test on the results. E. E. T. summarizes the remarks by pointing out that the test is merely a rapid indicator of the metal's probable behaviour under temperature and load, and does not provide a numerical relation between temperature, volume, and stress; nevertheless reliable information can be obtained as to the comparative behaviour of various metals under load at high temperatures in a relatively short time, and it must be remembered that structural changes occur in practice when a metal is kept under stress at high temperatures for prolonged periods.—A. R. P.

High-Temperature and Creep Testing of Metals. (I.) I. Musatti and A. Reggiori. (II.) H. Dustin. (III.) F. Körber (*Congrès du Chauffage Industriel* (Preprint), Group 1, Sect. 3, 1933, 8 pp., 10 pp., 16 pp.; *Bull. B.N.F.M.R.A.*, 1933, (60), 17).—M. and R. deal with equipment for high temperature and creep testing, D. with the high temperature testing of steels as carried out by him at Brussels, while K. deals generally with creep testing and properties of steel. —S. G.

Thermal Auto-Stabilization : Applications of the Study of High-Temperature Steels. G. Ranque and P. Henry (*Congrès du Chauffage Industriel* (Preprint), Group 1, Sect. 3, 1933, 16 pp.; *Bull. B.N.F.M.R.A.*, 1933, (60), 16).—"Thermal auto-stabilization" is the name applied by the authors to Rohn's method of creep testing. Stress is laid on the importance of maintaining constancy of length of test-piece. Automatic apparatus for applying this method to steels at high temperature is described and discussed.—S. G.

***Some Factors Affecting Strain Measurements in Tests of Metals.** R. L. Templin (*Amer. Soc. Test. Mat. Preprint*, 1934, June, 1-13).—This paper is based on results of a large number of tests carried out for the purpose of affording a comparison of deformations on various elements of both tension and compression specimens of various forms in both the elastic and plastic ranges. The testing procedure has been laid out for the purpose of determining the effects of eccentric and oblique loadings on the specimens; the effects of different types of testing machine jaws on the deformations obtained, and the effects of different types of plugs in the case of the hollow round tension specimens. The results obtained indicate definitely the need for uniform and axial loading of specimens, especially when determining the elastic modulus. Under such conditions of testing, it appears relatively unimportant whether strains are measured on one or more elements of the specimen. Under conditions of non-uniform or non-axial loading, it would appear necessary to determine strains simultaneously on opposite elements of a specimen in order to obtain satisfactory values for modulus of elasticity. The test conditions for obtaining satisfactory yield-strength values are much less exacting than those for obtaining satisfactory modulus values.—S. G.

***An "Overnight" Test for Determining Endurance Limit.** H. F. Moore and H. B. Wishart (*Proc. Amer. Soc. Test. Mat.*, 1933, 33, (II), 334-340; discussion, 341-347).—For abstract of the paper see *J. Inst. Metals*, 1933, 53, 517. The discussion, in which J. B. Kommers, R. E. Peterson, R. L. Templin, T. McL. Jasper, A. V. de Forest, E. H. Dix, Jr., H. J. Gough, E. E. Thum, and H. F. M. took part, ranges round the reliability of short-time fatigue tests, the general consensus of opinion being that the number of cycles recommended is insufficient with many materials to develop a crack of such size and shape as to overcome the hardening effect of the cyclic stresses. H. F. M. stated that no evidence had been found to indicate that any general structural change occurs during the test, but the crack spreads at an accelerated rate as the test proceeds. E. E. T. suggested that the surface hardness should be explored at the reduced section in slightly over-sized specimens, which are then machined to the exact dimensions to remove the metal disturbed by the hardness tests; this would overcome objections that the hardness is determined at points other than those subjected to the fatigue test.—A. R. P.

***Fatigue Tests on Galvanized Wire under Pulsating Tensile Stress.** S. M. Shelton and W. H. Swanger (*Proc. Amer. Soc. Test. Mat.*, 1933, 33, (II), 348-360; discussion, 361-363).—The limiting range of pulsating tensile stress, *i.e.* the "tensile fatigue limit" of commercially galvanized wire 0.192 in. in diameter has been determined at mean stresses of 50,000-150,000 lb./in.², the results for each mean stress are plotted on *S-N* diagrams, and the limiting ranges for the various mean stresses are plotted on a single diagram for each type of wire (cold-drawn and heat-treated). In all cases the tensile fatigue limit is practically

independent of the mean stress within the above range; it is determined by the magnitude of the range of stress rather than by the value of the maximum stress. No experiments have been made to determine the effect of galvanizing on the endurance properties. The discussion, in which *R. L. Templin, H. J. Gough, and H. F. Moore* took part, is entirely concerned with the behaviour of ferrous metals in endurance tests.—A. R. P.

***A High-Speed Fatigue-Testing Machine and Some Tests of Speed Effect on Endurance Limit.** G. N. Krouse (*Amer. Soc. Test. Mat. Preprint, 1934, June, 1-5*).—K. presents a shorter and less expensive method of determining the endurance limits of materials by the use of a high-speed fatigue-testing machine driven by an air turbine, operating over a range of speeds from 5000 to 30,000 r.p.m. Two inexpensive specimens are described with the critical section approaching the ideal and worst surface conditions. The results of tests on 4 steels, 2 cast irons, brass, and Duralumin, covering a wide range of endurance limits and speeds are presented. Check tests made on the slower-speed rotating-beam machine show that the speed effect may be estimated with a fair degree of accuracy and is of small import when compared with the effect of surface finish.—S. G.

Autographic Stress-Strain Curves of Deep-Drawing Sheets. Reid L. Kenyon and Robert S. Burns (*Trans. Amer. Soc. Steel Treat., 1933, 21, 577-601*; discussion, 601-612).—A description is given of the design and manipulation of an autographic apparatus for drawing stress-strain curves for sheet tensile specimens. A special curve-measuring ruler and its use are also described. Tensile stress-strain curves obtained with the new autographic attachment are shown, some of which give an experimental confirmation of the theory that the sharp yield-point in mild steel is related to stretcher-straining. A method is developed for computing the depth of the stretcher-strains from the amount of elongation through the yield-point. Curves are given for sheet material that has received various percentages of cold-rolling. True stress curves have been constructed from autographic stress-strain curves of sheet samples and these are discussed briefly. The stress-strain curve is shown to furnish considerable information concerning the behaviour of deep-drawing sheet material in addition to that obtained from the ordinary tensile test. The yield-point elongation and the uniform elongation are specific examples of significant values that can be determined only from accurate autographic stress-strain curves.—S. G.

Characteristics of the Huggenberger Tensometer. R. W. Vose (*Amer. Soc. Test. Mat. Preprint, 1934, June, 1-12*).—V. describes the behaviour of the Huggenberger Tensometer as determined by the use of a specially designed interferometer calibrator. It is first shown that under any fixed condition of use the readings of the instrument are proportional to the motion involved, and second that this factor of proportionality varies markedly with different conditions of use. The conditions covered include variations in mounting pressure, material of the specimen, balance and position of the instrument, seating on the specimen, and friction within the instrument. An attempt is made to analyze the causes of these effects and to suggest means for their remedy. From figures obtained in calibration, the accuracy of the instrument is calculated and the deviations to be expected in routine use are indicated.—S. G.

The Torsion Impact Test. G. V. Luerssen and O. V. Greene (*Proc. Amer. Soc. Test. Mat., 1933, 33, (II), 315-327*; discussion, 328-333).—For abstract of the paper see *J. Inst. Metals, 1933, 53, 652*. The use of the test in determining the effect of heat-treatment on steel is discussed by *Howard Scott, H. S. Rawdon, Haakon Styri, A. L. Davis, A. V. de Forest, Archibald Hurgren*, and the authors.—A. R. P.

Mechanical Hardness Influenced by Magnetism and Measured by Magnetostrictive Effects. S. R. Williams (*Trans. Amer. Soc. Steel Treat., 1933, 21, 741-768*).—The paper deals with the problem of mechanical hardness and the

methods employed to measure it. At present there is no uniformity in the measurements of hardness. Hardness is one thing for one manufacturing plant and something else for another. In studying the changes in length of ferromagnetic rods, when magnetized longitudinally, it was found that variations in mechanical hardness varied this magnetostrictive effect in a very interesting way. This longitudinal change of length in a magnetic field was, in fact, found to have possibilities as a means for measuring hardness. An extensive study has been made of this relation between magnetostriction and mechanical hardness. During the study it was discovered that a magnetization process itself produces changes in hardness. The first effect is to reduce the hardness.—S. G.

Factors in the Presentation and Comparison of Particle Size Data. E. J. Dunn, Jr., and John Shaw (*Proc. Amer. Soc. Test. Mat.*, 1933, 33, (II), 692-703).—Discusses certain important factors affecting the presentation and comparison of particle size data. Some problems of measurement are briefly discussed. Various graphical forms of presenting data are listed and summarized. Four accurately sized products giving diversified ranges of size are used in certain illustrative graphs. The present status and use of representative functions of particle size data are described. The need for standardization of methods of particle size analysis and presentation of data is emphasized.—S. G.

RADIOLOGY.

Radiographic Examination of Fillet Welds. W. Grimm and F. Wulff (*Autogene Metallbearbeitung*, 1934, 27, 101-104).—The effect of unequal cross-sections of parent metal is removed by using wedges of the same material, suitably placed. Special cassettes of convex shape are recommended, and methods of application for various types of weld are illustrated.—H. W. G. H.

Some Limitations of X-Ray Inspection of Welds. A. S. Douglass (*J. Amer. Weld. Soc.*, 1934, 13, (2), 15-16; discussion 16).—By tack-welding machined blocks of weld metal in a joint, a condition of imperfect fusion was simulated. Radiographs failed to show the presence of any flaw, and it was concluded that lack of fusion in a welded joint can escape detection in an X-ray examination. In the discussion Gilbert E. Doan and J. E. Waugh point out that, in practice, lack of fusion is always accompanied by porosity and slag inclusions which are clearly shown on a radiograph. Bela Ronay refers to the danger of unfused areas in planes almost parallel to the beam of X-rays.—H. W. G. H.

The Use of X-Rays for Engineering Test Purposes by the German State Railways. Anon. (*Welding Ind.*, 1933, 1, 337-339; 1934, 2, 21-23, 115-117).—Systematic inspection of welded, forged, and cast parts is said to have improved the quality of product and effected economies in manufacture. The methods used for examining fire-boxes are described. Gas cylinders, also, are tested at regular intervals to prevent possible failures from hidden defects or damage in service. A completely equipped X-ray van, with dark-room and power generator, is used for outdoor inspection of welded steel structures and reinforced concrete work. Special precautions have to be taken against vibration, which causes blurring of the skiagraph, and special film holders are used to keep the film close to the part under examination. Specimen radiographs of a welded plate girder are shown.—H. W. G. H.

Relative Merits of Film and Paper for Industrial X-Ray Work. Ancel St. John and H. R. Isenburger (*Proc. Amer. Soc. Test. Mat.*, 1933, 33, (II), 761-769).—See *J. Inst. Metals*, 1933, 53, 655.—S. G.

Sensitivity of the Gamma-Ray Method of Radiography. John T. Norton and Alfred Ziegler (*Trans. Amer. Soc. Metals*, 1934, 22, 271-279; discussion, 279-288).—See *J. Inst. Metals*, 1933, 53, 656.—S. G.

XII.—TEMPERATURE MEASUREMENT AND CONTROL

(Continued from pp. 313-314.)

A New Thermocouple for the Determination of Temperatures up to at Least 1800° C. G. R. Fitterer (*Trans. Amer. Inst. Min. Met. Eng.*, 1933, 105, Iron Steel Div., 290-297; discussion, 297-301).—For abstract of the paper see *J. Inst. Metals*, 1933, 53, 265. The discussion is concerned solely with the utility of the graphite-carborundum couple in measuring the temperature of molten slag and metal in the steelworks.—A. R. P.

The Technique of Sputtering Sensitive Thermocouples. Louis Harris and Ellis A. Johnson (*Rev. Sci. Instruments*, 1934, [New], 5, 153-158).—The technique of producing sensitive thermocouples by cathodic sputtering of bismuth, antimony, and tellurium on thin cellulose is described.—J. S. G. T.

XIII.—FOUNDRY PRACTICE AND APPLIANCES

(Continued from pp. 314-315.)

Some Aspects of Non-Ferrous Founding. A. Logan (*Found. Trade J.*, 1934, 50, 321-322).—Discussion of a paper read before the Lancashire Branch of the Institute of British Foundrymen, and L.'s reply. See *Met. Abs.*, this volume, p. 257.—J. H. W.

The Use of Sodium Carbonate in Foundry Practice. N. L. Evans (*Met. Ind. (Lond.)*, 1934, 44, 514; and *Found. Trade J.*, 1934, 50, 303; discussion 303 and 310).—Abstract of a paper read before the Sheffield Branch of the Institute of British Foundrymen. Describes the use of an improved form of sodium carbonate, known as "Granular Ash," for use in ferrous and non-ferrous founding.—J. H. W.

Magnesium-Chromium as a Deoxidizer of Copper. Charles Vickers (*Metalurgia*, 1934, 10, 43).—The utilization of a combination of chromium-copper and magnesium-copper as a deoxidizer for copper, gun-metal, red and yellow brass, and other common copper alloys is discussed. Various experiments are described, which indicate that chromium-magnesium in suitable proportions added to the molten bath in such a way that it is immediately immersed in the bath has an excellent effect on copper and its alloys. In the case of copper it has a distinct influence in improving electrical conductivity, when compared with deoxidizing agents such as silico-calcium copper, calcium carbide and calcium borax, and calcium boride, and in the case of the copper alloys it acts as a decided strengthener.—J. W. D.

Fluxes and Slags in Brass Foundry Melting Practice. T. Tyrie (*Met. Ind. (Lond.)*, 1934, 44, 461-464, 487-496, 540-541).—Abstract of a paper read before the Scottish Section of the Institute of Metals. A description is given of the more commonly occurring impurities in non-ferrous metals, of their influence on the physical properties of the metals, and of their removal by the use of fluxes and slags, and some test figures obtained from metal so treated are given.—J. H. W.

Studies in Cast Bronzes. Francis B. Rowe (*Found. Trade J.*, 1934, 50, 363-364, 366).—Abstract of a paper read before the Institute of British Foundrymen. The variation of the density with the casting temperature between 1250° and 1000° C., of bronzes containing 5-15% of copper, with or without phosphorus, has been investigated. The results of physical tests on bars cut from test rings cast with the bars are recorded.—J. H. W.

Casting a Pressure Chamber in Special Bronze. Friedrich Wilhelm (*Z. ges. Giesserei-Praxis: Das Metall*, 1934, 55, 141-142).—Details of moulding and casting a pressure chamber in bronze are given.—J. H. W.

Bells—Their History and Manufacture. E. Denison Taylor (*Edgar Allen News*, 1934, 12, 423-425, 434-436).—The history of bells is considered with reference to their development in design, size, and methods of sounding, special attention being given to certain well-known bells. The founding of bells is also considered with reference to the moulding of the cope and core, the metal used, and the time of cooling. It is also stated that where steel has been used for bells, it has been replaced by bronze in almost every case.

—J. W. D.

Problems on the Casting of Brass Bars. Werner Fröhlich (*Z. ges. Giesserei-Praxis: Das Metall*, 1934, 55, 162-164).—Details on the casting of brass bars are given. Water-cooled iron moulds are recommended for rapid cooling and a compact structure. Structural defects are caused by replenishing an already filled mould during solidification of the metal. Cold air must not be admitted in pouring from the ladle, and casting should be done at 950°-1110° C. The composition of the flux to be used is discussed.—J. H. W.

Preparation and Casting of Aluminium-Brasses. E. T. Richards (*Metallbörse*, 1934, 24, 408, 438-439, 470).—The advantages of addition of aluminium to brass are detailed, the precautions to be observed in obtaining sound castings pointed out, and the causes of unsound castings discussed.—A. R. P.

The Casting of Albanoid. Anon. (*Met. Ind. (Lond.)*, 1934, 44, 444, 449; *Found. Trade J.*, 1934, 50, 262).—Albanoid, a nickel-brass containing approximately 20% of nickel, and melting at 1095° C., should be poured at 1250°-1400° C. after fairly rapid melting under a flux. Although the alloy contains a slight excess of manganese, it should be deoxidized with magnesium. The pouring, moulds, chill-casting, use of scrap, and the causes of various types of unsoundness are discussed.—J. H. W.

The Manufacture of Bearings. Anon. (*Automobile Eng.*, 1934, 24, 169-173).—The manufacture of anti-friction metals and finished bearings by highly specialized production methods is described. Two principal alloys containing more than 87% tin and no lead are dealt with, and the melting and mixing of these alloys, the foundry for casting the bearing shells, the press shop for the production of shells in steel and non-ferrous metals, the white-metalling, as well as the machining are described in detail, special reference being made to melting equipment, presses, and methods of running both in hand die-casting machines, and centrifugal casting machines.

—J. W. D.

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

(Continued from p. 315.)

The Remelting of Aluminium in Reverberatory Furnaces. E. T. Richards (*Chem.-Zeit.*, 1934, 58, 135-136).—Reverberatory furnaces with a deep hearth are suitable for remelting aluminium scrap provided that precautions are taken to avoid absorption of oxygen, nitrogen, and hydrocarbon gases; fireclay or bauxite bricks and oil- or gas-firing are recommended. The temperature in the furnace should not exceed 750° C., and a reducing atmosphere free from suspended carbon particles or smoke should be maintained. The choice of suitable fluxes is discussed.—A. R. P.

The Production of New Ingot Aluminium from Scrap. H. Reininger (*Giesserei*, 1934, 21, 115-119).—A review of modern practice in the recovery of a good grade of aluminium from scrap.—A. R. P.

Reclamation of Copper Wire. Anon. (*Bull. Nat. Elect. Light Assoc.*, 1933, 20, 66-69).—Inspection and reclamation are centralized. A table is given showing some 38 classes into which scrap wire is divided, according to its condition and potential use. Wire of similar class is spliced in order to give

longer lengths. Occasionally the joints are soldered, or, more often, electrically brazed.—W. A. C. N.

On the Use of Copper-, Bronze-, and Brass-Scrap in the Foundry. E. R. Thews (*Z. ges. Giesserei-Praxis: Das Metall*, 1934, 55, 245-247).—The method of sorting copper and copper-alloy scrap, the composition and nature of the scrap likely to be met with, and the methods of using it in foundry work are described.—J. H. W.

XV.—FURNACES AND FUELS

(Continued from pp. 316-317.)

Application of Reversed Combustion to Industrial Furnaces. — Richard (*Congrès du Chauffage Industriel* (Preprint), Group 4, Sect. 1, 1933, 9 pp.; *Bull. B.N.F.M.R.A.*, 1933, (60), 14).—Reversed combustion consists, e.g., in the combustion of air in gas, instead of the more usual direct combustion of gas in air. Gas furnaces based on this principle are described. The apparatus is somewhat complicated. Its application appears unlikely except in special cases, e.g., where treatment in absence of air is necessary. Its application to special aluminium alloys, complex brasses, bronze, &c., is suggested.—S. G.

Heating of Rotatory Melting Furnaces and Their Application. — Boutigny (*Congrès du Chauffage Industriel* (Preprint), Group 4, Sect. 1, 1933, 14 pp.; *Bull. B.N.F.M.R.A.*, 1933, (60), 13).—Includes short notes on the application of these furnaces, using oil fuel, to the melting of bronzes, refining of copper, melting of nickel and copper-nickel alloys and of aluminium.—S. G.

Heat-Treatment Furnaces. A. G. Robiette (*Heat-Treat. and Forging*, 1934, 20, 147-148).—The use of artificial atmospheres, of producer gas, liquid ammonia, cracked gas, and steam in heat-treating furnaces is described.

—J. H. W.

Metals in Furnace Construction. — Bassal (*Congrès du Chauffage Industriel* (Preprint), Group 4, Sect. 1, 1933, 21 pp.; *Bull. B.N.F.M.R.A.*, 1933, (60), 13).—A general survey of knowledge, mainly ferrous. Deals with metal as the outer frame of the furnace; metal in contact with fire, including sections on strength at high temperatures and resistance to oxidation; and metal as a heating agent (electric resistance alloys).—S. G.

The Application of Electric Energy in New Types of Metal Melting Furnaces. A. Karsten (*Metallbörse*, 1933, 23, 1601-1602, 1633-1634).—Several types of small induction furnaces (high- and low-frequency) are described and illustrated.

—A. R. P.

Coreless Induction Furnaces. W. Reche (*Wiss. Veröff. Siemens-Konzern*, 1933, 12, 1-33; *Sci. Abs.*, 1933, [B], 36, 506).—A continuation of previous work. A method of calculating the heat liberated in coreless induction furnaces from the equation of the magnetic field is given. The solution also provides a description of the distribution of the eddy currents, a result which is checked experimentally. A method is now available for taking all the factors into account in designing the dimensions of the coils and selecting the frequency for operation.—S. G.

Heat-Losses in Electric Furnaces. V. Paschkis (*Elekt. u. Masch.*, 1933, 51, 368-370; *Sci. Abs.*, 1933, [B], 36, 506).—P. estimates theoretically the steady heat losses during continuous working of a rectangular resistance furnace with single or multiple walls. It is known that a multiple-layer furnace wall, of which the various wall thicknesses are interdependent because of temperature-drop considerations, passes a minimum steady heat loss for some particular wall thickness. The thickness for minimum loss depends on the furnace size.

—S. G.

Resistance Furnaces in Great Britain. A. G. Lobleby (*World Power*, 1933, 20, 86-89; *Sci. Abs.*, 1933, [B], 36, 628).—Summary of a paper read before the

(1933) World Power Conference. Recent progress in design of low temperature furnaces tends to the use of more efficient air circulation, thus making for small temperature gradients and more uniform heating. Both centrifugal- and propeller-type fans are employed, and the air flow may be turbulent; the circulation should provide for closely packed charges. Fans also improve the efficiency of recuperative processes. Other improvements are in improved methods of handling the material, e.g., a patented recuperative revolving-drum furnace with internal helix for annealing small parts, working an 8-hr. day with 65 kw.h. per ton (size not stated). Continuous furnaces show much higher load factors and give greater uniformity of product than those of the batch type. Resistance furnaces are in increasing use for the melting of non-ferrous metals and alloys.—S. G.

XVI.—REFRACTORIES AND FURNACE MATERIALS

(Continued from pp. 318–320.)

Refractories and Super-Refractories. (I.) D. Petit. (II.) — Maire (*Congrès du Chauffage Industriel* (Preprint), Group 4, Sect. 1, 1933, 6 pp. and 4 pp.; *Bull. B.N.F.M.R.A.*, 1933, (60), 18).—P. deals with recent progress in the production of industrial refractories, M. with carbon silicide and fused alumina and their applications.—S. G.

Tercod—A New Refractory. G. S. Diamond (*Ceramic Age*, 1934, 22, 133–134).—Tercod consists of a mixture of silicon carbide, with or without graphite, a carbon bond, and a protective borosilicate glaze to prevent oxidation. The properties have been determined, and show that the thermal expansion coeff. of Tercod is less than half that of any other known refractory. Tercod is resistant to non-ferrous metals, although slightly attacked by lead at high temperatures.—E. S. H.

Improved Chrome Cement. Anon. (*Eng. and Min. J.*, 1934, 135, 237).—A note on a cement consisting of chrome ore with a high chromic oxide and low silica content. Graded grain-size, smoothness and plasticity, are the special claims.—R. Gr.

The Baking of Refractories and Their Constancy to Dimensions. — Vey (*Rev. Mat. constr. trav. publ.*, 1934, (295), 76B–77B).—Suitable, standardized, uniform and adequate heating eliminates many sources of weakness in the finished refractory product. V. considers that the modern continuously running regenerative furnace is the most economical in operation, and that, contrary to some opinions, alumina and silico-alumina bricks may be correctly treated in furnaces of this type. The special characteristics of furnace and materials are summarized, and the question of replacement is briefly considered.—P. M. C. R.

XVII.—HEAT-TREATMENT

(Continued from p. 320.)

†**Heat-Treatment of Metallurgical Products.** A. Portevin (*Aciers spéciaux*, 1934, 9, (101), 2–23).—This dissertation is concluded under the following headings: heat-treatment of light aluminium alloys (those containing either or both Mg_2Si and $CuAl_2$) and their equilibrium diagrams; the mechanism of quenching and heat-treating these alloys, and its conception as a thermal cycle; the study of annealing and general considerations of heat-treatment; analogies and differences between the tempering of steels and that of light alloys; structural and precipitation hardening; hot-resistance and hot-hardening alloys; general considerations for the quenching of solid alloys; different types of quenching; analogy with the phenomena at solidification.—J. H. W.

*On the Age-Hardening of the Cast Alloy of Aluminium with 9% MgZn₂ and Its Mechanical and Corrosion Properties. Heinz Günther Wiechell (*Forschungsarb. Metallkunde u. Röntgenmetallographie*, 1933, (14), 45 pp.; *Chem. Zentr.*, 1934, 105, I, 2483).—The capacity of castings of the aluminium alloy with 9% MgZn, for age-hardening is not inferior to that of the rolled alloy; degassing before casting does not improve the tensile strength. The strength at high temperatures compared with that of the 8% copper-aluminium alloy and that of K.S.—Seewasser is extraordinarily high, and the resistance to corrosion by sea-water is as good as that of the K.S.—Seewasser alloy. Addition of small quantities of titanium has a deleterious effect on all the properties.—A. R. P.

XVIII.—WORKING

(Continued from pp. 320-322.)

Lead Cable Sheath Extrusion. Waldo L. Sherman (*Wire and Wire Products*, 1934, 9, 103-113).—As a result of a series of studies of the defects which sometimes occur in extruded lead cable sheath, it was found that: (1) the size of the lead crystals does not have any apparent effect on the strength of the lead sheath, (2) when excessive inclusions are not present, the sheath will probably fail at its thinnest part, (3) weaknesses are not ordinarily due to the die-block weld, (4) when the inclusions are few, satisfactory sheathing is produced with regular lead encasing die-blocks, (5) attention must be given to (a) inclusions, (b) wall uniformity, (c) extrusion speed, (d) wall thickness, and (e) shrinkage. These conclusions are illustrated by a large number of photomicrographs.

—J. H. W.

Chromium-Coated Cutting Tools. Otto Scholl (*Werkstatt u. Betrieb*, 1934, 67, 192).—A note on the advantages of chromium-plating as a protective medium, a repairing medium, and an auxiliary to the lubrication and cooling of cutting tools.—P. M. C. R.

XIX.—CLEANING AND FINISHING

(Continued from pp. 322-323.)

Abrasives in Metal Polishes. Cyril S. Kimball (*Chem. Industries*, 1934, 34, 209-214).—Commercial metal polishes may be divided into four classes: (i) neutral naphtha base, (ii) naphtha base-ammonia, (iii) water base-pine oil, and (iv) water base-ammonia, silica sand of different types and grades being used in all cases as the abrasive. The characteristics of these types are discussed with reference to several examples.—A. R. P.

New Lacquers for Enamelled Wire. H. Courtney Bryson (*Indust. Chemist*, 1934, 10, 145-146).—The processes involved in the drawing and lacquering of copper wire for electrical purposes are described. Brief notes are given on methods of testing the finished wire.—E. S. H.

XX.—JOINING

(Continued from pp. 323-325.)

Hammering Copper Welds. P. Tree (*Machinist (Eur. Edn.)*, 1934, 78, 173E).—A short note describing how copper welds should be hammered. Start hammering at the end of the weld, using light blows at first and have the work at red heat. Avoid annealing if possible, but if not, heat to 750° F. (400° C.) for 30 minutes and cool slowly.—J. H. W.

On the Repair of Bronze Bells. R. Meslier (*Rev. Soudure autogène*, 1934, 26, 12-13).—Practical hints are given for welding cracked bells. "Bronze

welding" is recommended, mainly because it removes the necessity for pre-heating the whole bell.—H. W. G. H.

"Bronze-Welding." Anon. (*Soudeur-Coupeur*, 1934, 13, (2), 1-25).—A series of short articles on the technique and applications of bronze-welding to various materials, including brasses, bronzes, galvanized iron, and ferrous metals. The joining of different materials, such as iron to copper, is also described.—H. W. G. H.

Rebuilding with Monel Metal. Anon. (*Oxy-Acetylene Tips*, 1934, 13, 62-63).—The exposed ends of nitrided steel valve stems were being rapidly corroded by acid spray. The worn stems were built up with Monel metal by the oxy-acetylene process, using a reducing flame.—H. W. G. H.

Contraction Stresses in Welds. Hans Schmuckler (*Welding Ind.*, 1934, 2, 74-78).—The causes of distortion due to welding are explained and some methods for avoiding or reducing it are described. The results of some recent researches, to estimate contraction and contraction stresses after welding, are reviewed, and it is pointed out that these differ surprisingly from theoretical estimates.—H. W. G. H.

Our Present Knowledge of the Tension Conditions within Welding Ribbons. D. Rosenthal (*Bull. Tech. Suisse Romande*, 1934, 60, 87-89, 113-117).—Read at the Welding Congress, Lausanne, 1932. A study of the stresses in certain types of welded joint under specified conditions reveals certain inconsistencies with existing theory. A bibliography is given.—P. M. C. R.

Combined Stresses in Fillet Welds. Cyril D. Jensen (*J. Amer. Weld. Soc.*, 1934, 13, (2), 17-21).—Three methods of stress analysis, for fillet welds placed at right angles to the load, are examined in the light of tests made to determine the strength of welds loaded by two forces at right angles. It is concluded that further investigation of stresses in fillet welds is required.—H. W. G. H.

***Stresses in Transverse Fillet Welds by Photoelastic Methods.** Arshag G. Solakian (*J. Amer. Weld. Soc.*, 1934, 13, (2), 22-29).—Stress distributions in Bakelite models representing fillet welds were analyzed by photoelastic methods. A complete stress analysis was made for a 45° C. transverse fillet-welded lap joint and maximum shear stress distributions were determined for many other types of transverse fillets. The weld "leg" parallel to the load was found to be the critical section for elastic stresses, the shear stress being very high along this section, with pronounced stress concentrations at the root and the neck. Along the other "leg," normal to the load, the stress was pure tension. Stress concentration was reduced by increasing the length of the shear "leg" and by replacing the sharp re-entrant angle with a smooth curve. Oversized fillets were found to be of no advantage, but undersized fillets and undercutting at the neck were objectionable.—H. W. G. H.

Fatigue of Metals [Welds]. G. E. Thornton (*J. Amer. Weld. Soc.*, 1934, 13, (3), 20-25).—The application of fatigue testing to welded joints is reviewed. It is suggested that the primary causes of low fatigue strength in welds are flaws, adjacent areas of large and small crystals, and differences in hardness between weld and parent metal. Rotating beam machines, various types of test-piece, and typical results, are described.—H. W. G. H.

Bending Tests of Welds. H. N. Boetcher (*J. Amer. Weld. Soc.*, 1934, 13, (2), 31-32).—The many limitations of the usual forms of bending test are said to be overcome by changing the plane of bending, the specimens being sawn off, unmachined, and bent sideways so as to deform the entire cross-section of the weld uniformly.—H. W. G. H.

The Development of Welding Technique. D. Richardson (*Welding Ind.*, 1934, 2, 41-42, and 47).—The importance of controlled technique in blowpipe welding is emphasized. The history, development, and scope of the method known as "backward" or "rightward" welding are discussed.—H. W. G. H.

The Development of Resistance Welding Electrical Power Control Devices. Rufus L. Briggs (*J. Amer. Weld. Soc.*, 1934, 13, (3), 8–11).—An historical survey of the control of welding current for resistance welding machines is followed by a brief account of modern equipment used in conjunction with timing devices. Some typical controls are shortly described.—H. W. G. H.

Mixtures of Acetylene and Oil-Gas. Anon. (*Rev. Soudure autogène*, 1934, 26, 10).—The addition of oil-gas lowers the temperature of the oxy-acetylene flame and produces no better results than would be obtained with additions of air or nitrogen.—H. W. G. H.

The New Welding Machine [of] S. A. Frap. R. Meslier (*Rev. Soudure autogène*, 1934, 26, 6–9).—Describes an automatic oxy-acetylene welding machine in which the fillet rod is fed with a gyratory motion and an auxiliary air-acetylene flame is played on to the molten bath to keep it in a reducing atmosphere.—H. W. G. H.

XXI.—INDUSTRIAL USES AND APPLICATIONS

(Continued from pp. 325–329.)

Aluminium Drums for Chemicals. H. V. Churchill (*Chem. Industries*, 1934, 34, 215–216).—The construction of aluminium drums for shipping concentrated nitric acid, acetic acid, and 30% hydrogen peroxide is briefly described.—A. R. P.

Installation of Aluminium Alloys in Vessels of the United States Navy. — (*Bureau of Construction and Repair, U.S. Navy Dept. Pamphlet*, 1933, April, 12 pp.; *Bull. B.N.F.M.R.A.*, 1934, (61), 4).—This pamphlet has been issued in order to disseminate the present knowledge of the application of aluminium alloys to shipbuilding, particularly methods to be followed and precautions to be taken to secure satisfactory installations. Various sections deal with contact with other materials, working fits, forming of various alloys, welding, riveting, machining, heat-treatment, and preservation.—S. G.

The Application of Aluminium in Heavy Vehicle Construction. Roland Sterner-Rainer (*Automobiltech. Z.*, 1934, 37, 220–223).—The increasing use of aluminium and its alloys is reviewed historically. Tables show the composition of (1) common alloys for casting; (2) high-strength cast or forged alloys, with description of treatment; (3) non-corroding alloys; (4) piston alloys of important copper content; (5) piston alloys of important silicon content. A list of vehicle parts where light alloys are or can be employed is illustrated photographically and with diagrams of chassis and engine.—P. M. C. R.

The Use of Duralumin in Commercial Vehicle Body Construction. E. L. Oglethorpe (*J. Inst. British Carriage Manuf.*, 1934, April; and (abbreviated) *Aluminium Broadcast*, 1934, 4, (28), 1–10).—Read before the Institute of Consulting Motor Engineers. Methods of using Duralumin in the construction of various classes of vehicle bodies are discussed, the advantages of the material for this purpose outlined, and examples given of the savings which follow the resulting reduction in dead weight.—J. C. C.

Making an Old Bridge Lighter. R. G. Skerrett (*Compressed Air Mag.*, 1934, 39, 4401–4405).—Cf. *Met. Abs.*, this volume, p. 326. An illustrated account of the replacement with light alloy members of the steel floor system of the Smithfield Street Bridge, Pittsburgh, U.S.A. The fabrication and working of the new members are described, and mechanical properties and applications are tabulated for the 4 alloys used (4 SH, 53 ST, 27 ST, 17 ST). The method of riveting is described, and dimensions, weights, and costs are given.—P. M. C. R.

Thermal Insulation with Aluminium Foil. J. F. O. Stratton (*Power Plant Eng.*, 1934, 38, 241–242).—S. traces the development by Schmidt and Dykerhoff of Pecelet's principle of foil insulation. Alternative methods of spacing are

considered, and tables show the relative thermal conductivity of aluminium foil as compared with 8 common heat-insulators, the surface temperatures of aluminium foil insulation of different numbers of layers on steam pipes, and the influence of the number of air-spaces on conductance values.—P. M. C. R.

Heat Transmission Through Aluminium Paper. A. F. Dufton (*J. Inst. Heating Ventilating Eng.*, 1933, 1, 334-336; *Bull. B.N.F.M.R.A.*, 1933, (60), 4).—The results of experiments carried out at the National Physical Laboratory using aluminium paper (stout paper or similar material covered on both sides with aluminium foil) are described. They indicate that a closed air-space, not less than $\frac{3}{4}$ in. wide and bounded on one or both sides by a plane bright metallic surface, affords insulation equivalent to $\frac{1}{2}$ in. of cork.—S. G.

Minimum Specification for Fixing Cold-Water Services. — (*Inst. Plumbers Minimum Specification No. 2*, 1933, 9 pp.; *Bull. B.N.F.M.R.A.*, 1934, (63), 20).—The aim of this and other specifications of the Institute of Plumbers is to lay down a minimum of sound practice, and to reconcile local variations in various parts of the country. The present specifications deal with weight, strength, and thickness of pipe (lead, B.N.F. ternary alloy, copper, brass); fixing of pipes; storage cisterns; and precautions against frost.—S. G.

Advances in the Use of Elektron and Hydronalium in Heavy Vehicle Construction. — Keinert (*Automobiltech. Z.*, 1934, 37, 250-256).—Elektron finds increasing application for motor crank-cases, wheels, gear-cases, frames, and smaller die-cast parts. An outstanding advantage is the suitability of the material for autogenous welding. Important modifications in wheel and crank-case design have been necessitated by the use of light alloys: these improvements are shown diagrammatically. Elektron can, by careful construction and by insulation from wood and from other metals, be kept relatively free from corrosion, but Hydronalium is employed by preference where corrosive attack is expected.—P. M. C. R.

On the Use of Tantalum in the Chemical Industry. Ralph W. Harbison (*Metallbörse*, 1934, 24, 533-534).—The preparation and properties, especially the resistance to attack by chemicals, of tantalum are described.—A. R. P.

XXII.—MISCELLANEOUS

(Continued from p. 329.)

Information and Research Bureaux for the Metal Industries in France. J. Cournot (*Bull. Soc. Belge Ing. et Indust.*, 1933, (8), 737-786; *Bull. B.N.F.M.R.A.*, 1934, (62), 21).—An account of various French organizations which act as research and/or information centres for various metal and allied industries, including those dealing with welding, aluminium, nickel, cadmium, steel, molybdenum, founding, and beryllium.—S. G.

Metallurgical Research Work in Slavonic Countries. Anon. (*Univ. Birmingham Russian Dept. Pamphlets*, 1933; *Bull. B.N.F.M.R.A.*, 1933, (59), 19).—These pamphlets give lists of researches, in all branches of science, in progress in Poland and Czechoslovakia in 1931-1932. There are no details. In Poland, W. Broniewski is working on the structure of alloys, the effect of cold-work on mechanical properties, and the relation of composition to magnetic properties; and E. Geisler on metal cutting. In Czechoslovakia, F. Hasa is investigating the mechanical properties of copper at high temperatures and the resistance and arc welding of copper.—S. G.

The Importance of Metallurgy to the Engineer. C. H. Bulleid (*Proc. Inst. Mech. Eng.*, 1932, 123, 767-772).—An abridged version of a lecture delivered before the East Midlands Branch of the Institution of Mechanical Engineers. A number of examples are described of cases in which a knowledge of metallurgy

would have enabled the engineer to diagnose the cause of failures of metal parts, and to suggest suitable materials.—W. H.-R.

Copper Industry Approves Code and Selects Code Authority. Anon. (*Eng. and Min. J.*, 1934, 135, 220-226).—Outlines the articles which include under Article II definitions of the words and phrases used in the metallurgical world. Copper, primary copper, secondary copper, by-product copper, custom copper, fire-refined copper, &c., are amongst those defined.—R. Gr.

***On the Copper Age in Ancient China.—III.** Tsurumatsu Dōno (*Bull. Chem. Soc. Japan*, 1934, 9, 120-124).—[In English.] Analysis of an ancient spear-head showed it to contain copper 84.78, lead 6.02, and tin 0.24% (balance mainly iron). Two ancient halberds contained copper 88.14, lead 6.64, and copper 85.86, lead 13.05% respectively, with only a trace of tin. A halberd of apparently later date contained copper 84.92, tin 13.74%. These results support the previous argument in favour of the existence of a copper age and a transitional period in China prior to the bronze age.—E. S. H.

The Origin of Bronze. Cecil H. Desch (*Newcomen Soc. Advance Copy*, 1934, 8 pp.).—The weight of evidence seems to be in favour of the theory that the Egyptians, Sumerians, and other early workers in bronze and copper obtained their metal by smelting copper carbonate ores either alone or with tinstone from alluvial or vein deposits. The sources from which the ores were obtained have not, however, yet been definitely identified except in a few cases.—A. R. P.

Planning for the Collection of Standardization Data. J. R. Townsend (*Proc. Amer. Soc. Test. Mat.*, 1933, 33, (II), 770-785).—Written from the point of view of the work of the A.S.T.M., this paper deals with a method of planning for the collection of standardization data. Two engineering investigations leading to standardization by the A.S.T.M. are discussed as illustrations of how this method of planning works out in practice. The method of planning discussed is recommended for use and is explained in its broader aspects as well as in the details of its application to the 2 specific problems.—S. G.

Industrial Research: A Business Man's View. (Sir) Kenneth Lee (*Roy. Institution Reprint*, 1933, Dec. 15, 16 pp.; *Bull. B.N.F.M.R.A.*, 1934, (62), 21).—The author is Chairman of the Industrial Grants Committee of the Department of Scientific and Industrial Research. He illustrates the application of research methods to an industrial problem by an interesting account of an investigation, carried out by his own company, on the reduction of creasing in cotton fabrics. He urges the provision of more funds for research.—S. G.

Application of Statistical Methods to Production and Research in Industry. R. H. Pickard (*Roy. Statistical Soc. Preprint*, 1933, 4 pp.; *Bull. B.N.F.M.R.A.*, 1934, (61), 22).—Deals with the application of statistical methods to specification and sampling, to control of quality, to planning of laboratory or industrial investigations (in order to balance or average out uncontrolled variations), and to problems of management and production.—S. G.

Research in Relation to Industry. A. P. M. Fleming (*Inst. Indust. Administration Papers*, 1932-1933, 24-31; *Bull. B.N.F.M.R.A.*, 1934, (62), 21).—One function of research in relation to industry is to improve the efficiency of industrial operations, with special reference to tools, measurements, conversion processes, materials, labour, and design. The other is to create new knowledge and new industries, and this involves bridging the gap between discovery and application. Various aspects of these matters are discussed.—S. G.

XXIII.—BIBLIOGRAPHY

(Continued from pp. 330-334.)

(Publications marked * may be consulted in the Library.)

- Alloys. *Directory of Iron, Steel, and Non-Ferrous Alloys*. Demy 8vo. Pp. 30. 1933. Cleveland, O.: Johnson Publishing Co. (25 cents.)
[Published as a supplement to the September 1933 issue of *Machine Design*.]
- *American Society for Testing Materials. *A.S.T.M. Standards on Preservative Coatings for Structural Materials [Paints, Varnishes, Lacquers, and Paint Materials]*. Prepared by Committee D-1 on Preservative Coatings for Structural Materials. Med. 8vo. Pp. v + 350, illustrated. 1933. Philadelphia, Pa.: The Society, 260 S. Broad St. (\$1.25.)
[Reprinted from the Society's volume of Standards.]
- *American Society for Testing Materials. *Proceedings of the Thirty-Sixth Annual Meeting held at Chicago, Illinois, June 26-30, 1933*. Med. 8vo. Volume 33. Part I.—*Committee Reports; New and Revised Tentative Standards; Tentative Revisions of Standards*. Pp. xii + 1092, illustrated. Part II.—*Technical Papers*. Pp. v + 804, illustrated. 1934. Philadelphia, Pa.: The Society, 260 S. Broad St. (Per part: heavy paper, \$5.50; cloth, \$6.00; half-leather, \$7.00.)
- Bain, H. F., and W. G. Schneider. *Copper*. Pp. 20. 1933. New York: Copper and Brass Research Association.
- *Barronia Metals, Ltd. *Copper Alloys for the Engineering Industries*. Post 8vo. Pp. 132, illustrated. [1934.] London: Barronia Metals, Ltd., Parsons Green, S.W.6.
- Beljajew, P. P. *Electrolytic Lead Coatings*. [In Russian.] Pp. 80. 1933. Moscow and Leningrad: Goschimtechisdat. (Rbl. 1.)
- *Bennett, H. Editor-in-Chief. *The Chemical Formulary. A Condensed Collection of Valuable, Timely, and Practical Formulae for Making Thousands of Products in All Fields of Industry*. Demy 8vo. Pp. x + 595. 1933. Brooklyn, N.Y.: The Chemical Formulary Co., 950 Third Ave. (\$6.00.)
- Bielov, A. F. *A Study of Some Properties of Light Rollable Alloys*. [In Russian.] Pp. 48. 1933. Moscow: Gosudarstvennoe Nauchno-Tekhnichestvoe Izdatelstvo. (Rbl. 1.20.)
- *Brauer, Adolf, und Josef Reitstötter. Herausgegeben von. *Fortschritte des chemischen Apparatewesens*. Dargestellt an Hand der Patentschriften des Deutschen Reiches unter Mitwirkung zahlreichen Fachgenossen mit Unterstützung der DECHEMA, Deutsche Gesellschaft für chemisches Apparatewesen, E.V. *Elektrische Öfen*. Unter Mitwirkung von O. Feussner, W. Fischer, Theo. Frantz, K. F. Frhr. v. Göler, G. Müller, V. Paschkis, M. Pirani, J. Rossman, F. Singer, F. Sommer, G. Stig, F. Walter gemeinsam mit den Herausgebern bearbeitet durch H. Alterthum. Lieferung 1. Imp. 8vo. Pp. iv + 64 + 96 + 16. 1934. Leipzig: Akademische Verlagsgesellschaft m.b.H. (R.M. 20.)
- Brillouin, Léon. *Conductibilité électrique et thermique des métaux*. (Actualités Scientifiques et Industrielles. No. 89.) Roy. 8vo. Pp. 71 + 3. 1933. Paris: Hermann et Cie. (18 francs.)
- *Briscoe, H. V. A., and Janet W. Matthews. *Micro-Chemical Methods Suitable for General Analytical Practice*. (Two Lecture Demonstrations.) Demy 8vo. Pp. 42, with 37 illustrations. 1934. London: Institute of Chemistry, 30 Russell Sq., W.C. 1. (Members, 2s.; non-members, 2s. 6d.)

- ***British Aluminium Company, Ltd.** *Overhead Transmission Lines.* (No. 359, superseding No. 337.) 7 in. × 9 in. 1934. London: The Company, Adelaide House, King William St., E.C.4.
[Contains numerous data sheets.]
- ***British Standards Institution.** *British Standard Specification for Nickel Anodes (for Electroplating).* (No. 558.) Med. 8vo. Pp. 9. 1934. London: British Standards Institution, 28 Victoria St., S.W.1. (2s. 2d. post free.)
- Charnock, G. F.** *Mechanical Technology: Being a Treatise on the Materials and Preparatory Processes of the Mechanical Industries.* Second edition, revised and enlarged by F. W. Partington. Demy 8vo. Pp. xii + 725. 1934. London: Constable and Co., Ltd. (15s. net.)
- ***Corrosion. Korrosion III. Bericht über die Korrosionstagung 1933 am 14 November 1933 in Berlin veranstaltet von Deutsche Gesellschaft für Metallkunde, Verein deutscher Ingenieure, Verein deutscher Eisenhüttenleute, Verein deutscher Chemiker.** Demy 8vo. Pp. iv + 79, with 42 illustrations. 1934. Berlin: V.D.I. Verlag G.m.b.H.
[Contains the following papers: K. Laute, "Korrosion und Ermüdung"; A. Fry u. P. Schafmeister, "Interkristalline Korrosion in verschiedenen Metallen und Legierungen, insbesondere in rostfreien Stählen"; O. Dahl, "Über die Korrosionsfestigkeit der Bronzen"; R. Glauner, "Über den Zusammenhang zwischen Lösungsgeschwindigkeit, Lösungsmittel und Gitterkräften bei Kupfereinkristallen"; R. Kühnel, "Das wechselnde Verhalten von Zinkschutzplatten in den Kesseln der Reichsbahnfahrtschiffe"; E. Schumann, "Der Einfluss der Glühbehandlung auf die Korrosionsbeständigkeit von Kondensatorrohren"; — Eckert, "Fortschritte im Anstrich von Aluminium und Aluminiumlegierungen"; K. L. Meissner, "Neuere Versuche mit Duralplatt."]
- ***Deutsche Gesellschaft für Chemisches Apparatewesen E.V.** *Achema Jahrbuch.* Jahrgang 1931–1934. Berichte über Stand und Entwicklung des Chemischen Apparatewesens. Begründet von Max Buchner. Herausgegeben unter Mitwirkung von Fachgenossen aus Wissenschaft und Technik von der Dechema. Demy 8vo. Pp. 236 + 44. 1934. Hannover: Deutsche Gesellschaft für Chemisches Apparatewesen E.V. (R.M. 10.)
- ***Evans, Gilbert.** *Manufacture of Seamless Tubes, Ferrous and Non-Ferrous.* Cr. 4to. Pp. 187, with 129 illustrations. 1934. London: H. F. and G. Witherby, 326 High Holborn, W.C.1. (40s. net.)
- ***Feszczenko-Czopiowski, I.** *Metaloznawstwo. Część Druga. Stale Specjalne* (Nr. 1. Biblioteki "Prac Badawczych P.W.U.") Med. 8vo. Pp. x + 357, with 284 illustrations. 1934. Warsaw: Nakładem Państwowych Wytwórni Uzbrojenia w Warszawie Skład Główny w Księgarni Technicznej w Warszawie.
- Gratschew, K. F.** *Science of Metals.* [In Russian.] Pp. ii + 278. 1933. Moscow, Leningrad, and Swerdlowsk: Metallurgisdat. (Rbl. 4.40.)
- ***Gregg, S. J.** *The Adsorption of Gases by Solids.* Fcap. 8vo. Pp. viii + 120, with 15 illustrations. 1934. London: Methuen and Co., Ltd. (2s. 6d. net.)
- Handy and Harman.** *18th Annual Review of the Silver Market. The Gold Situation in the Arts and Industries.* Pp. 51. 1933. New York: Handy and Harman.
- ***Hessischen Hochschulen.** *Werkstofftechnisches Kolloquium der Staatlichen Materialprüfungsanstalt an der Technischen Hochschule, Darmstadt, am 24 Juni 1933.* Jahrgang 1933. Heft 2. Demy 8vo. Pp. 74, illustrated. 1933. Darmstadt: Technische Hochschule.
- ***Herty, C. H., Jr., and M. B. Royer.** *Solubility of Carbon in Iron-Manganese-Silicon Alloys.* (U.S. Bureau of Mines, Report of Investigations

No. 3230.) 4to. [Mimeographed.] Pp. 22, with 6 illustrations. 1934. Washington, D.C.: Bureau of Mines.

- ***Hoare, W. E.** *Tin-Iron Alloy in Tinplate, with Notes on Some Imperfections.* (Technical Publications of the International Tin Research and Development Council, Series A, No. 2.) Demy 8vo. Pp. 12, with 24 illustrations. 1934. London: International Tin Research and Development Council.

[A paper read before the Iron and Steel Institute; see *Met. Abs.*, this volume, p. 305.]

- ***Hothersall, A. W., S. G. Clarke, and D. J. Macnaughtan.** *The Electrodeposition of Tin from Sodium Stannate Solutions with the Use of Insoluble Anodes.* (Technical Publications of the International Tin Research and Development Council, Series A, No. 1.) Med. 8vo. Pp. 101-124, with 10 illustrations. 1934. London: International Tin Research and Development Council.

[A paper read before the Electrodepositors' Technical Society.]

- ***Imperial Institute.** *Annual Report, 1933, by the Director, Lt.-Gen. Sir William Furse, K.C.B., D.S.O., to the Board of Governors.* 4to. Pp. 57. 1934. London: Imperial Institute, S.W.7. (2s.)

- ***International Acetylene Association.** *Official Proceedings. Thirty-Fourth Annual Convention of the International Acetylene Association, Congress Hotel, Chicago, September 26-29, 1933.* 8vo. Pp. xiii + 214, illustrated. 1934. New York: International Acetylene Association, 30 East 42nd St.

[Contains the following papers: J. M. Moreland, "A Century of Progress in Acetylene"; J. H. Critchett, "Heat-Treatment by the Oxy-Acetylene Process"; J. C. Hartley, "Reconditioning Rail Ends"; A. L. Prentice, "Profitable Scrapping of Locomotives and Cars"; M. R. Winther, "Air Conditioning in Passenger Cars"; J. A. Nieuwland, "Basic Research Possibilities in Acetylene and Calcium Carbide"; H. A. Frommelt, "A Programme of Training and Education for the Welding and Cutting Industry"; W. R. Campbell, "Training for Welding in Refrigeration"; G. O. Carter, "Importance of the Technician's and Welder's Ingenuity"; H. L. Whittemore, "The Welding of Thin Wall Tubing"; F. W. Rabe, "Rehabilitating the Brewing Industry"; F. C. Fantz, "Fabricating Piping Systems by Welding"; R. S. McBride, "Fabricating Alloy Steels for the Process Industries"; H. G. Marsh, "Welded Rolled Steel Construction in Steel Plant Equipment"; R. L. Binder, "Metals Coating."]

- ***Iron and Steel Institute.** *The Journal of the Iron and Steel Institute. Subject and Name Index to Vols. CV-CXXIV, 1922-1931, and to Vols. XI-XX of the Carnegie Scholarship Memoirs.* Demy 8vo. Pp. 307. 1934. London: The Institute, 28 Victoria St., S.W.1. (16s.)

- ***Jones, W. D., and W. E. Hoare.** *A Microscopic Examination of Iron-Tin Reaction Products.* (Technical Publications of the International Tin Research and Development Council, Series A, No. 3.) Demy 8vo. Pp. 8, with 2 figures in the text and 1 plate. 1934. London: International Tin Research and Development Council.

[Read before the Iron and Steel Institute; see *Met. Abs.*, this volume, p. 345.]

- ***Linde Air Products Company.** *The Testing and Qualification of Welders.* Med. 8vo. Pp. 21, with 22 illustrations. 1933. New York: The Company, 205 East 42nd St.

- ***Lucas, Francis F.** *A Precision High-Power Metallographic Apparatus.* (Bell Telephone System Technical Publications. Metallurgy. Monograph B-771.) Med. 8vo. Pp. 23, and 12 illustrations. 1933. New York: Bell Telephone Laboratories, Inc., 463 West St.

[See *J. Inst. Metals*, 1933, 53, 649.]

- Meier, W.** *Umbau von Werkzeugmaschinen. Teil 1.—Spangebende Maschinen. Von A. Schroeder. Teil 21.—Maschinen für spanlose Formung.* By W. Meier. Pp. 21, with 122 illustrations. 8vo. 1934. Leipzig: J. A. Barth. (R.M. 2.40.)

- ***Maybrey, H. J.** *Piston Material and Design*. A Paper read before a Meeting of the Diesel Engine Users Association on 14th February, 1934, and Report of Discussion. F^ocap. Pp. 20, with 3 illustrations. 1934. London: Diesel Engine Users Association, 307 Abbey House, S.W.1. (3s.)
- Mohr, W., and R. Kramer.** *Die Metalle in der Milchwirtschaft*. Teil 5. *Die korrodierende Einwirkung verschiedener "Kühlsohlen" auf kombinierte Metalle*. Pp. 47, illustrated. 1933. 8vo. Leipzig: J. A. Barth.
- ***National Physical Laboratory.** *Tests on Volumetric Glassware*. Demy 8vo. Pp. 34, with 6 illustrations. 1934. Teddington: National Physical Laboratory. (Gratis.)
- Nordheim, Lothar.** *Die Theorie der thermoelektrischen Effekte; Legierungen, unvollständige Ketten, Benedickseffekt*. (Actualités scientifiques et industrielles, No. 131.) Roy. 8vo. Pp. 23 + 3. 1934. Paris: Hermann et Cie. (6 francs.)
- Odquist, F.** *Plasticitetsteorie med Tillämpningar*. Pp. 80. 1934. Stockholm: Generalstabens Litografiska Anstalts Förlag.
- Olivo, Mario.** *Guida pratica del fonditore*. Pp. 282, illustrated. 8vo. Milan Casa Editrice E.R.T.A. (Lire 20.)
- ***O'Neill, Hugh.** *The Hardness of Metals and Its Measurement*. Roy. 8vo. Pp. xiv + 292, with 119 illustrations. 1934. London: Chapman and Hall, Ltd. (25s. net.)
- Redman, L. V., and A. V. H. Mory.** *The Romance of Research*. Cr. 8vo. Pp. 149. 1933. New York: D. Appleton-Century Co. (\$1.00.)
- Richtmyer, F. K.** *Introduction to Modern Physics*. (International Series in Physics.) Second edition. Med. 8vo. Pp. xviii + 747, with 6 plates. 1934. New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd. (30s. net.)
- Rideal, Eric Keighley.** *On Phase Boundary Potentials*. (Actualités scientifiques et industrielles, No. 83.) Pp. 17. 1934. Paris: Hermann et Cie. (4 francs.)
- Scarpa, O.** *Pile metalliche, che funzionano in eccezione alla legge delle tensioni elettriche nei circuiti metallici*. (Actualités scientifiques et industrielles, No. 84.) Pp. 22. 1934. Paris: Hermann et Cie. (6 francs.)
- Snamenski, A. P.** *Handbook for Metalworkers*. [In Russian.] Sixth edition. Part I. Pp. viii + 751. 1933. Leningrad and Moscow: Gosmaschmetisdat. (Rbl. 8.50.)
- ***Steger, Hans.** *Metallgiesserei*. Lieferung 1. Pp. 30. Lieferung 2. Pp. 31-54. Lieferung 3. Pp. 55-84. Illustrated. Potsdam: Bonness u. Hachfeld. (R.M. 0.90.)
- ***Technische Hochschule, Aachen.** *Abhandlungen aus dem Institut für Metallhüttenwesen und Elektrometallurgie der Technischen Hochschule, Aachen*. Begründet von Wilhelm Borchers. Neue Folge. Herausgegeben von Paul Röntgen. Band II. 4to. Pp. 107, illustrated. 1934. Aachen: Technische Hochschule.

[Contains the following papers, which are with one exception reprinted from various sources: Paul Röntgen u. Rudolf Buchkremer: "Der Einfluss von metallischen Verunreinigungen auf die technische Zink-elektrolyse" (see *J. Inst. Metals*, 1933, 53, 450); Paul Röntgen u. Heinz Borchers: "Herstellung und Elektrolyse von Schwefelaluminium" (see *Met. Abs.*, this volume, p. 23); Paul Röntgen u. Heinz Borchers: "Gewinnung von Reinaluminium"; Heinz Borchers: "Resistenzgrenze-Goldscheidung" (see *J. Inst. Metals*, 1933, 53, 139); Walter Roth: "Betrachtungen über das Erstarren von Metallblöcken" (see *J. Inst. Metals*, 1933, 53, 657); Paul Röntgen u. Hermann Braun: "Über die Löslichkeit von Gasen in Metallen. Das Verhalten von Wasserstoff und Stickstoff gegen Aluminium" (see *J. Inst. Metals*, 1932, 50, 721); Paul Röntgen u. Fritz Möller: "Untersuchungen über den Wasserstoffgehalt in Zink

mit besonderer Berücksichtigung von Elektrolytzink" (see *J. Inst. Metals*, 1933, 53, 115); Paul Röntgen u. Fritz Möller: "Über die Löslichkeit von Gasen in Kupfer und Aluminium" (see *Met. Abs.*, this volume, p. 226); Günther Schwietzke: "Porositäts-Erscheinungen und Ursachen in Nichteisenmetallguss" (see *Met. Abs.*, this volume, p. 174); Paul Röntgen u. Willy Koch: "Einfluss von Schwermetallen auf Aluminiumlegierungen, Teil I." (see *J. Inst. Metals*, 1933, 53, 694); Paul Röntgen u. Wilhelm Donicke: "Über das Warmwalzvermögen binärer und komplexer Kupfer-Zink-Legierungen" (see *Met. Abs.*, this volume, p. 232.)

*Timoshenko, S. *Theory of Elasticity*. (Engineering Societies Monographs.) Med. 8vo. Pp. xvi + 416, with 203 illustrations. 1934. New York: McGraw-Hill Book Co., Inc. (\$5.00); London: McGraw-Hill Publishing Co., Ltd. (30s. net).

*U.S. Bureau of Mines. *Progress Reports—Metallurgical Division*. 3.—*Studies in the Metallurgy of Copper*. (U.S. Bureau of Mines, Report of Investigations No. 3228.) 4to. Pp. 63. 1934. Washington, D.C.: Bureau of Mines.

*U.S. Department of Commerce, Bureau of Standards. *Radium Protection for Amounts up to 300 Milligrams*. (Bureau of Standards Handbook No. 18.) Cr. 8vo. Pp. 5. 1934. Washington, D.C.: Superintendent of Documents. (5 cents.)

*United States Government Printing Office. *Annual Report of the Public Printer, 1933*. Demy 8vo. Pp. 130. 1934. Washington, D.C.: Government Printing Office.

[Contains the report of the Technical Director.]

Vanderschueren, René. *Le Zinc. Les minerais de zinc, la technologie du zinc, le zinc métal*. Pp. 397. 1934. Paris: J.-B. Baillièere et fils. (Br., 24 francs.)

Väth, A. *Der Schleuderguss* (DIN A5). Pp. viii + 107, with 81 illustrations. 1934. Berlin: VDI-Verlag G.m.b.H. (Br., R.M. 6.90.)

Wensorski-Troitzi, N. L. *The Metallurgy of Mercury and the Development of the Production of Mercury in the U.S.S.R.* [In Russian.] Pp. 86. 1933. Moscow, Leningrad, and Swerdlowsk: Metallurgisdat. (Rbl. 1.25.)

Wien, W., und F. Harms. Herausgegeben von. *Handbuch der Experimental-Physik*. Band XII.—*Elektrochemie*. Teil 2. Herausgegeben von F. Fajans und E. Schwartz. Pp. 483. Leipzig: Akademisches Verlagsgesellschaft m.b.H. (M. 40.)

Wiss, E. Herausgegeben von. *Arbeiten mit der Schneidbrenner*. Pp. 94, with 202 illustrations. 1934. Berlin: VDI-Verlag G.m.b.H. (R.M. 9.)

THESES.

Evers, Alfred. *Über die Festigkeitseigenschaften von unvergüteten und vergüteten Aluminium-Sandguss-Legierungen im Vergleich mit Gusseisen und Stahlguss*. Pp. 63, with 12 plates. 1932. Munich: Bibliothek der Technischen Hochschule. (M. 8.)

Hodge, J. M. *Deoxidation of Steel with Manganese-Silicon-Aluminium Alloys*. Pp. 19. 1932. Pittsburgh, Pa.: Carnegie Institute of Technology.

Lutz, Otto. *Recherches sur les dosages et la séparation du nickel et du zinc*. Pp. 21. 1930. Geneva: Universitäts Bibliothek.

Neumann, F. *Die Verschweissung von Kupfers mittels des elektrischen Lichtbogens*. Pp. 56. 8vo. Berlin: Universitäts Bibliothek.

Rieber, Jean. *Beiträge zur Kenntnis der Metallnitride*. Pp. 45. 1930. Hannover: Universitäts Bibliothek.