

# METALLURGICAL ABSTRACTS

(GENERAL AND NON-FERROUS)

1933

SEPTEMBER

Part 9

## I.—PROPERTIES OF METALS

(Continued from pp. 433-435.)

**An Investigation of the Electrochemical Properties of Light Metals and their Alloys.—I.** Masuo Kawakami (*Kinzoku no Kenkyu*, 1933, 10, (5), 211-219).—[In Japanese.] This paper deals with the preliminary measurement of the single potentials of aluminium in various solutions with respect to the normal calomel electrode, for the purpose of obtaining information concerning the electromotive behaviour of aluminium.—S. G.

**An Allotropic Transformation of Barium in the Solid State.** E. Rinck (*Compt. rend.*, 1931, 193, 1328-1330; *C. Abs.*, 1932, 26, 1492).—The melting point of pure barium prepared by distillation under argon is  $710^{\circ} \pm 2^{\circ}$  C. Discontinuities at  $375^{\circ}$  C. in the cooling curve and in the electrical conductivity indicate transformation into an allotropic form at this temperature.—S. G.

**Variation of the Magnetic Properties of Barium with Temperature.** [Allotropy of Barium.] C. T. Lane (*Phys. Rev.*, 1933, [ii], 44, 43-45).—The mass susceptibility of barium has been determined above room temperature, and increases from  $+0.147 \times 10^{-6}$  at  $20^{\circ}$  C. to  $+0.415 \times 10^{-6}$  at  $400^{\circ}$  C. The susceptibility-temperature curve shows a break at  $350^{\circ}$  C., indicating that two modifications exist; this agrees with the work of Rinck (preceding abstract), who found a sharp break in the electrical resistance-temperature curve at  $370^{\circ}$  C. The existing theory of paramagnetism cannot account for the present curves showing an increase in paramagnetic susceptibility with increasing temperature. Details are given for the preparation of rods of barium free from contamination.—W. H.-R.

**The Thermal Expansion of Bismuth Single Crystals.** T. L. Ho and A. Goetz (*Phys. Rev.*, 1933, [ii], 43, 213).—Abstract of a paper read before the American Physical Society. The thermal expansion of bismuth crystals with known admixtures of electronegative and electropositive impurities in small concentrations has been determined between room temperature and the melting point. The decline of the expansion coeff. before the melting point, as reported previously by Roberts and by the authors, could be verified; it was found, furthermore, that admixtures cause definite changes in the thermal expansion at temperatures characteristic for the impurity present, which is interpreted by the influence such admixtures have on the habitus of the mosaic structure of these crystals.—S. G.

**Magnetostriction in Bismuth Single Crystals.** A. Wolf and A. Goetz (*Phys. Rev.*, 1933, [ii], 43, 213).—Abstract of a paper read before the American Physical Society. The magnetostriction of bismuth single crystals has been measured in the longitudinal field of a solenoid at approx. 20,000 gauss in two different directions to the principal axis [111] of the crystal. The observations were made in stationary field conditions which renders the experiments isothermal in contradistinction to the adiabatic method of Kapitza. The crystals of pure bismuth gave as moduli of magnetostriction (defined by  $\Delta l/l = H^2/2 \times m_{11}$ )  $m_{11} = +5.7 \times 10^{-16}$  and  $m_{11} = -7.0 \times 10^{-16}$ ; i.e. the dilatation occurs parallel to [111] and a contraction normal to [111] measured in the direction of the field lines. These values support Kapitza's recent measurements fairly well quantitatively. Furthermore, the influence of foreign atoms embedded in the crystal was checked and the effects found have been compared with the known influences on crystal diamagnetism,

For impurities with one valency less than bismuth (lead, tin) a decrease of  $m_{\perp}$  was found which caused the effect to disappear ( $m_{\perp} = 0$ ) at concentrations of 0.45% for tin and 1.9% for lead. For larger concentrations the effect changes its sign into a dilatation in which finally the values are almost twice as large as the original ones. The atomic influence on the magnetostriction reaches 0 in the neighbourhood of concentrations close to the solubility limit of the admixture in bismuth. Similar but more complex effects were found for  $m_{\parallel}$ . Electronegative impurities (tellurium) have influences similar to the previously reported effects of electronegative admixtures on crystal-diamagnetism.—S. G.

**An Allotropic Transformation of Calcium in the Solid State.** E. Kinck (*Compt. rend.*, 1931, 192, 421-423; *C. Abs.*, 1931, 25, 2355).—Heating and cooling curves for calcium exhibit a horizontal portion that reveals a point of transition between two solid forms of calcium. Below 450° C. the stable form is  $\alpha$ -calcium; between 450° C. and the melting point at 848° C. the stable form is  $\beta$ -calcium. The curve of electrical resistance vs. temperature exhibits a break at 450° C. The change from  $\beta$ - to  $\alpha$ -calcium involves contraction in volume. Attempts to retain  $\beta$ -calcium at room temperature by rapid cooling were unsuccessful.—S. G.

**Measurement of Contact Potential Differences between Different Faces of Copper Single Crystals.** H. E. Farnsworth and B. A. Rose (*Phys. Rev.*, 1933, [ii], 43, 375).—Abstract of a paper read before the American Physical Society. Measurements on contact potential difference between the (111) and (100) faces of single crystals of copper, as a function of the time of outgassing in a high vacuum, were made by the standard Kelvin null method. Care was first taken to obtain smooth surfaces etched parallel to the desired planes with practically no etching parallel to other planes. Two sets of observations with different experimental tubes show that the (111) face assumes a positive potential with respect to the (100) face. This value increases rapidly from near zero to about 0.4 v. during the first few hours of outgassing at dull red heat, and then more slowly to a limiting value of  $0.463 \pm 0.002$  at 70 hrs. and remains constant to at least 150 hrs. In one case the value decreased by further heating at temperatures which exposed other faces by evaporation. Observations were taken at a pressure of about  $10^{-7}$  mm. mercury as measured on an ionization gauge. Although the present outgassing is not complete, it is more than that required to reduce the surface gas layer to such a thickness that it possesses a definite crystal structure related to that of the underlying copper, as shown by Farnsworth. Hence, the above result should be characteristic of surface gas crystals on copper.—S. G.

**Atomic Weight of Lead from Cyrtolite.** G. P. Baxter and Chester M. Alter (*Science*, 1932, 76, 524-525; *C. Abs.*, 1933, 27, 639).—The lead from thorium-free cyrtolite from Bedford, N.Y., U.S.A., was extracted by hydrofluoric acid and purified by recrystallization of the nitrate and chloride, and by sublimation in hydrochloric acid. A weighed quantity of the fused salt was precipitated with a weighed, nearly equivalent amount of pure silver, and the end-point of the reaction determined nephelometrically by the equal opalescence method. Comparison experiments were carried out with common lead (atomic weight 207.22) and lead from Swedish kohl (atomic weight 206.01). The average atomic weight of lead from cyrtolite was 205.924, indicating the practical absence of common lead, wherefore the lead-uranium ratio may be used for the geological age estimation. The low value is difficult to understand in the light of (1) Aston's value of the isotopic weight of radium-lead,  $205.98 \pm 0.02$ , if the factor for converting from the physical to the chemical scale is 1.00022; and (2) the ratio of  $Pb^{208}$  to  $Pb^{207}$  in pure uranium lead from Katanga, which is 93.3 to 6.7 as found by Aston. The minimum atomic weight to be expected is 206.03.—S. G.

**The Solubility of Metallic Lithium in Liquid Ammonia at Low Temperatures.** Warren C. Johnson and M. M. Piskur (*J. Physical Chem.*, 1933, 37, 93-99).—The vapour pressures of solutions of lithium in liquid ammonia have been determined at high lithium concentrations at 0° C., — 32.7° C., — 33.2° C., and — 63.5° C. The results show that the solubility of metallic lithium in liquid ammonia increases appreciably from — 63.5° C. to 0° C.—J. S. G. T.

**The Electrochemical Properties of Light Metals and their Alloys.—II.** Masuo Kawakami (*Kinzoku no Kenkyu*, 1933, 10, (5), 220-226).—[In Japanese.] The measurement of the single electrode potential of magnesium is dealt with. The experiments were carried out as in the case of aluminium (see *J.*, this volume, p. 481). The electrode potential of magnesium has been found generally more basic than with aluminium; the former, therefore, has been considered to be more easily corroded than the latter. The results present a general idea of the electrochemical behaviour of magnesium.—S. G.

**Empirical Formulæ for the Relation between the Temperature and Pressure of Saturated Vapour.** [Vapour Pressure of Mercury.] A. Adamson (*Mem. Proc. Manchester Lit. Phil. Soc.*, 1931-1932, 76, 1-9).—Empirical formulæ are given connecting the vapour pressures of saturated vapours with the temperature. For mercury between 100° and 420° C., the departure from experimental values of  $p$  is less than 0.4%, the pressure ranging from 0.28 to 1220 mm.—W. H. R.

**The Electrocapillary Maximum for a Mercury Electrode in Contact with a Solution containing Mercurous Ions.** S. R. Craxford (*Phil. Mag.*, 1933, [vii], 16, 66-79).—It is shown experimentally that the evidence, derived from two methods of determination, that the potential of the electrolytic null-point for a mercury electrode in contact with mercurous ions is near + 0.5 v., is really without value. The Gibbs method of treatment is inapplicable to the treatment of the polarized inter-phase, which is best discussed by the Lippmann treatment.—J. S. G. T.

**The Effect of High Electrostatic Fields on the Vaporization of Molybdenum.** G. B. Estabrook (*Phys. Rev.*, 1933, [ii], 43, 383).—Abstract of a paper read before the American Physical Society. It has been found for wires of varying diameters, that, (1) for field strengths of about  $0.52 \times 10^6$  v./cm. or less at the wire surface, there was no change in the rate of change of resistance with time and hence in the rate of vaporization on application of the field; (2) for field strengths above approx.  $0.52 \times 10^6$  v./cm., as successively higher fields were applied, the rate of vaporization first decreased slowly, then more rapidly, and finally asymptotically toward zero at field strength over  $1.8 \times 10^6$  v./cm.; (3) with increasing temperatures, the same field strength applied at the surface of a wire produced progressively smaller decreases in the rate of vaporization; (4) when there was an effect on the rate of vaporization, sudden increases in resistance occurred when the field was applied, and sudden decreases when it was removed. A decrease in vaporization rates was found for platinum, along with a sudden increase in resistance on applying the field, and a sudden decrease when the field was removed. Worthing has reported similar results for tungsten except that the sudden increases and decreases were opposite to those of platinum and molybdenum.—S. G.

**The Temperature Dependence of Young's Modulus for Nickel.** Jerrold Zacharias (*Phys. Rev.*, 1933, [ii], 44, 116-122).—A method is described for the measurement of Young's modulus. The metal in the form of a rod is cemented to a rod of quartz so as to form a composite piezo-electric oscillator by means of which the fundamental frequency of free longitudinal vibration of the rod can be determined, and is simply related to the Young's modulus. The moduli have been determined between 30° and 400° C. for single crystals of purified nickel containing 0.11% molybdenum, and for polycrystalline

commercial nickel annealed at various temperatures. With commercial nickel annealed at 900° or 1100° C. and then slowly cooled, the modulus first decreases with increasing temperature to form a minimum between 150° and 200° C., increases to a maximum at the Curie point, and then decreases linearly with temperature. A similar behaviour was noted for the single crystal slowly cooled from 1450° C. For commercial specimens heated to 700° C. and slowly cooled, and for all specimens quenched from 1100° C., the maxima and minima are absent, and the moduli diminish with increasing temperature, the curves showing changes in direction at the Curie points. The bearing of these results on the internal friction is discussed. [Note by Abstractor.—The synopsis refers to experiments on hard-drawn specimens, but these are apparently those heated to 700° C. and slowly cooled.]—W. H. R.

**The Contamination of Nickel Crystals Grown in a Molybdenum Resistance Furnace.** Andrew Dingwall, Jerrold Zacharias, and Sidney L. Siegel (*Electrochem. Soc. Preprint*, 1933, Sept., 395-400).—When high-purity nickel was melted in an aluminum crucible in a molybdenum wire-wound resistance furnace, the metal absorbed 0.1% of molybdenum. This contamination was avoided by surrounding the crucible with a gas-tight porcelain tube, but this led to contamination of the nickel by silicon, although to only a relatively small extent. These results show that before making physical measurements it is necessary carefully to test purified metals after melting and working to ascertain whether they have taken up any impurities.—A. R. P.

**Diffusion of Hydrogen through Palladium. Effect of Pressure, Temperature, and the State of Purity of the Metal.** Victor Lombard and Charles Eichner (*Compt. rend.*, 1933, 196, 1998-1999).—Measurements of diffusion were made with thin plates of commercial palladium after prolonged heating at about 500° C. in a current of hydrogen. The rate of diffusion of hydrogen from a region of pressure  $P$  to a region of vacuum was given, for various values of  $P$  up to atm. pressure, by  $D = KP^{0.55}$  with plates 0.097 and 0.099 mm. thick, but with a plate 1.027 mm. thick and at 490°-570° and 617° C., the equation became  $D = KP^{0.5}$ . In the case where the second region was under pressure  $P$ , the equation was  $D = K(P^{0.5} - p^{0.5})$ . For various temperatures between 350° and 850° C. the most satisfactory equation for

the "specific diffusion" was found to be  $D_{SN} = 20.73T^{1.2}e^{-T}$  (cm.³, hr., cm.², mm. thickness). The permeability of palladium is considerably affected by the purity of the metal.—J. H. W.

**X-Ray Scattering Power of Metallic Silver for  $K_{\alpha}$  Copper Radiation.** Ludwik Chrobak (*Z. Krist.*, 1933, 84, 475-477).—[In English.] Using particles of silver having a diam. of 0.001 mm., absolute intensities of the reflections have been obtained, and the  $F$ -values have been calculated therefrom.—E. S. H.

**Revision of the Atomic Weight of Tellurium. Analysis of Tellurium Tetra-bromide.** O. Hönigschmid, R. Sachtleben, and K. Wintersberger (*Z. anorg. Chem.*, 1933, 212, 242-256).—The analysis gave a value of 127.61 for tellurium.—M. H.

**The Extension of Tin Crystals.** J. Obinata and E. Schmid (*Z. Physik*, 1933, 82, 224-234).—Investigations of the extension of crystals of white tin confirm previous results relating to the two most important translatory systems, viz.  $t = \{001\}$ ;  $T = \{100\}$  or  $\{110\}$ . Which kind of translation occurs depends on the orientation of the tension. Translation characterized by  $t = [101]$ ;  $T = \{101\}$  occurs occasionally. Values of the critical thrust corresponding with these different systems of translation are all of about the same order of magnitude. With increasing slip, the thrust corresponding with both principal systems of translation increases only very slightly. Increase of temperature is characterized by a very small decrease of the

critical thrust. The observations do not afford any evidence of the existence of a high transformation temperature in the case of white tin.—J. S. G. T.

**The Measurement of the Viscosity of a Molten Metal [Tin] by Means of an Oscillating Disc.** Vaughan H. Stott (*Proc. Phys. Soc.*, 1933, 45, 530-544).—Observations of the logarithmic decrement of an alumina disc supported by a phosphor-bronze wire and executing torsional vibrations in molten tin are employed to determine the viscosity of tin at temperatures between 240° and 800° C. The following values of the viscosity (measured in poises) were found at the respective temperatures stated (° C.): 240°, 0.0191; 260°, 0.0182; 280°, 0.0174; 300°, 0.0167; 320°, 0.0160; 340°, 0.0154; 360°, 0.0148; 380°, 0.0143; 400°, 0.0138; 420°, 0.0133; 440°, 0.0129; 460°, 0.0125; 480°, 0.0122; 500°, 0.0118; 520°, 0.0115; 540°, 0.01125; 560°, 0.0110; 580°, 0.0107; 600°, 0.0105; 620°, 0.01025; 640°, 0.1005; 660°, 0.00985; 680°, 0.00965; 700°, 0.00945; 720°, 0.0093; 740°, 0.00915; 760°, 0.0090; 780°, 0.00885; 800°, 0.0087. Discontinuity in the viscosity-temperature curve of molten tin at temperatures near its freezing point is very improbable, and certainly does not occur at temperatures more than 6° C. above that point. The method of the oscillating disc is satisfactory, but it is desirable to verify the measurements of Sauerwald and his co-workers by the capillary tube method in order that full reliance may be placed on values of the viscosities of metals used for calibrating the apparatus.

—J. S. G. T.

**On the Dissolution of Metallic Tungsten by Ammoniacal Cupric Hydroxide Solution.** Theodor Millner (*Z. anorg. Chem.*, 1933, 212, 284-288).—Tungsten powder dissolves in ammoniacal cupric hydroxide solution yielding ammonium tungstate.—M. H.

**[Determination of] the Thermal Expansion of Zinc by the X-Ray Method.** E. A. Owen and John Iball (*Phil. Mag.*, 1933, [vii], 16, 479-488).—The crystal parameter of zinc has been measured at temperatures between 20° and 400° C. The crystal structure remains close-packed hexagonal throughout, indicating that no allotropic modification of zinc exists up to 400° C. The following values of the mean linear coeff. of expansion of zinc, perpendicular to (⊥) and parallel to (||) the hexagonal axis and mean volume coeff. of expansion were deduced for the respective temperature ranges: 20°-250° C., (⊥)  $1.5 \times 10^{-5}$ ; (||)  $5.3 \times 10^{-5}$ ; 7.2°  $\times 10^{-5}$ ; 20°-350° C., (⊥)  $1.7 \times 10^{-5}$ ; (||)  $5.5 \times 10^{-5}$ ; 8.2°  $\times 10^{-5}$ ; 20°-400° C., (⊥)  $1.6 \times 10^{-5}$ ; (||)  $5.9 \times 10^{-5}$ ; 8.9°  $\times 10^{-5}$ .—J. S. G. T.

**A Precise Determination of the Thermal Diffusivity of Zinc.** Richard H. Frazier (*Phys. Rev.*, 1933, [ii], 43, 135-136).—Using the method previously described (Frazier, this *J.*, 1932, 50, 595), the thermal diffusivity of very pure zinc was measured, and gives  $k/c = 2.832 \pm 0.004$  g.-cm.<sup>-1</sup>sec.<sup>-1</sup>, where  $k$  is the thermal conductivity, and  $c$  the specific heat. (See also following abstract).—W. H.-R.

**Purity of Zinc for which Thermal Diffusivity Recently was Reported.** R. H. Frazier (*Phys. Rev.*, 1933, [ii], 43, 762).—A note. Details of the analysis of the zinc used in F.'s work on thermal diffusivity (preceding abstract).

—W. H.-R.

**Report of Committee B-2 [of A.S.T.M.] on Non-Ferrous Metals and Alloys.** William Campbell and E. E. Thum (*Amer. Soc. Test. Mat. Preprint*, 1933, 1-5).—Mainly very brief summaries of the various sections of work under review by the sub-committees. The following requirements for special high-grade zinc are recommended for adoption: It shall not contain more than 0.010% lead, 0.005% iron, or 0.005% cadmium, and shall be free from aluminium. The sum of lead, iron, and cadmium shall not exceed 0.010%. The addition of lead to certain tin-base bearing alloys improves their physical properties. Various alterations in the electrolytic methods for determining copper and lead, mainly in the voltage to be employed, are noted.—W. A. C. N.

**Report of Joint Committee [of A.S.T.M. and A.S.M.E.] on Effect of Temperature on the Properties of Metals.** Progress Report to Sponsor Societies. H. J. French and N. L. Mochel (*Amer. Soc. Test. Mat. Preprint*, 1933, 1-4).—Reports are made on the progress of the following investigations: Test for short-time high-tension measurements on metallic materials and test for long-time (creep) high-temperature tension measurements of metallic materials.—W. A. C. N.

**Phenomena Occurring in the Melting of Metals.** W. L. Webster (*Proc. Roy. Soc.*, 1933, [A], 140, 653-660).—Experiments designed to investigate factors affecting the disappearance of crystallization nuclei in bismuth, cadmium, lead, or tin when a melt is heated above the conventional melting point are described. In bismuth, lead, and tin persisting nuclei remain when the solid is melted. In tin these nuclei are easily destroyed and are usually not re-formed until a definite degree of under-cooling is effected. In bismuth and lead the nuclei are apparently only very slowly destroyed as the melt is superheated, and to each stage of their destruction there corresponds a characteristic degree of under-cooling at which what remains of the nuclei recovers the power to act as a centre of crystallization. The nuclei exhibit a temperature hysteresis effect. An apparent lowering of the temperature of solidification of bismuth occurs in capillary tubes.—J. S. G. T.

**Surface Tension of Molten Metals.** A. I. Krynsky (*Metals and Alloys*, 1933, 4, 79-84).—A correlated abstract of recent work, especially on copper-tin, bismuth-tin, cadmium-antimony, zinc-antimony, lead-antimony, and aluminium-copper alloys and on many of the common base metals of low melting point. The importance of surface tension data for studying soldering and brazing problems is emphasized, methods of determining surface tension at high temperatures are discussed, and a plea is made for further work on the free-flowing properties of metals and alloys.—A. R. P.

**On the Effect of High Electrostatic Fields on the Vaporization of Metals.** A. G. Worthing (*Phys. Rev.*, 1933, [ii], 43, 383).—Abstract of a paper read before the American Physical Society. Work with tungsten and molybdenum (see Estabrook, *J.*, this volume, p. 483) shows that their vaporization rates may be altered greatly by electrostatic fields. Obviously there may be involved either the recapture by the external field of material vaporized presumably as dipoles, the actual prevention of vaporization, or both. Recapture of material vaporized as atoms on the dipole assumption alone fails because of the huge polarizabilities required. Recapture of material vaporized as large aggregations of atoms fails because the effect actually becomes appreciable only at fields of the order of a million volts/cm., though the prevention of vaporization is almost complete at fields 3 or 4 times this value. Production of electrostatically oriented surface layers of dipoles with consequent strengthening of the external field, similar to the strengthening of an external magnetic field by ferromagnetic material, with consequent recapture of vaporized metals fails quantitatively. The foregoing seems to exhaust possibilities of classical explanations of this effect. Further consideration is being given on the basis of quantum mechanics.

—S. G.

**Heat Content of Some Metals [Copper, Platinum, Brasses] and Slag Forming Constituents at Temperatures up to 1200° C.** Hans Esser, Robert Averdiek and Walter Grass (*Arch. Eisenhüttenwesen*, 1932-1933, 6, 289-292; and (abstract) *Stahl u. Eisen*, 1933, 53, 80).—The heat contents of copper up to 1250° C., platinum up to 1100° C., and various nickel-brasses and brasses, quartz, alumina, lime, and manganous oxide up to 1250° C. have been determined in a metal block vacuum calorimeter.—J. W.

**Gases in Metals.** V. H. Gottschalk and R. S. Dean (*Metallurgist* (Suppt. to *Engineer*), 1933, 9, 43).—A brief summary and discussion of a paper read

before the American Institute of Mining and Metallurgical Engineers. See this *J.*, 1932, 50, 470.—R. G.

**On the Theory of Frictional Oxidation.** Max Fink and Ulrich Hofmann (*Arch. Eisenhüttenwesen*, 1932-1933, 6, 161-164; and (abstract) *Stahl u. Eisen*, 1932, 52, 1026).—See *J.*, this volume, p. 340.—J. W.

**Fatigue of Metallic Materials.** Paul Ludwik (*Forschungen u. Fortschritte*, 1933, 9, 274).—A review of recent work. Under twisting and bending stresses below the yield-point the increase in endurance strength is approximately proportional to the applied stress both in the case of polished, and of notched or corroded, specimens.—J. W.

**The Magnetic Analysis of Internal Strains.—II.** M. Kersten (*Z. Physik*, 1933, 82, 723-728).—The change of remanence effected in certain ferromagnetic materials by tension or pressure, in accordance with Becker's theory, is used to deduce the value of the mean specific stresses in such materials. The values, so derived, in the case of plastically stretched nickel wire, agree with those deduced from values of initial permeability and the reversible work of magnetization.—J. S. G. T.

**Phase Boundary Potentials of Adsorbed Films on Metals. I.—The Behaviour of Oxygen on Gold. II.—The Behaviour of Iodine on Platinum. III.—The Examination of the Interaction of Copper and Iodine Vapour by the Method of Surface Potentials. I and III.**—Harold Kenneth Whalley and Eric Keightley Rideal. II.—Lewis Jacobs and Harold Kenneth Whalley (*Proc. Roy. Soc.*, 1933, [A], 140, 484-489, 489-496, 497-504).—(I.—) The surface potentials at gold or oxidized gold surfaces in nitrogen are determined. The results show that the potential difference between clean and oxidized gold is 1.56 v. (II.—) The rate of evaporation of iodine from the surface of platinum, on which a film of oxygen is present, is unimolecular in character, and the latent heat of evaporation is dependent on the phase boundary potential which can be altered by oxygen. (III.—) The evaporation of unimolecular layers of iodine from cuprous iodide is unimolecular in character, but the phase boundary potential between copper and iodine is altered by the presence of a layer of cuprous oxide. The phase boundary potential depends both on the thickness and the crystalline state of the cuprous oxide.—J. S. G. T.

**The Affinity of Metals for Sulphur. IV.—The Dissociation of the Sulphides of Zinc and Manganese.** E. V. Britzke, A. F. Kapustinsky, and B. K. Wesselowsky (*Z. anorg. Chem.*, 1933, 213, 65-70).—The dissociation pressures of zinc and manganese sulphides and the affinity of zinc and manganese for sulphur between 292° and 727° C. and between 407° and 1100° C., respectively, have been calculated from a study of the equilibria of the reactions between these sulphides and hydrochloric acid.—M. H.

**The Affinity of Metals for Sulphur. V.—General Conclusions.** E. V. Britzke and A. F. Kapustinsky (*Z. anorg. Chem.*, 1933, 213, 71-76).—*Inter alia*, the following order of decreasing affinity of metals for sulphur at 1000° abs. is given: zinc, manganese, cobalt, cadmium, copper, nickel, iron, lead, tin, silver, antimony, bismuth.—M. H.

**Polish on Metals.** R. C. French (*Proc. Roy. Soc.*, 1933, [A], 140, 637-652).—The structures of polished surfaces of copper, silver, gold, and chromium have been examined by electron diffraction using cathode rays. The results show that highly polished surfaces are almost amorphous, thus confirming Beilby's theory. In some cases the distance between atoms in the polished surface differed appreciably from that in normal crystals. Kirchner's conclusion that polishing consists only in a levelling of the crystalline surface is not supported.—J. S. G. T.

**Recrystallization Phenomena in Synthetic Metal Bodies.** F. Sauerwald (*Naturwiss.*, 1933, 21, 467).—A short confirmatory note on the work of W. Trzebiatowski, *J.*, this volume, p. 226.—J. W.

**Use of Metals in Firing Processes of Vitreous Enamelware.** Clyde E. Williams (*Ceram. Ind.*, 1932, 18, 179-180).—See this *J.*, 1932, 50, 532.—S. G.

**The Thermal and Electrical Conductivities of Several Metals [Iron, Tungsten, Molybdenum, Silver] between  $-183^{\circ}$  C. and  $100^{\circ}$  C.** W. G. Kannulnik. Appendix: C. E. Eddy and T. H. Oddie (*Proc. Roy. Soc.*, 1933, [A], 141, 159-168).—An electrical method of determining the thermal and electrical conductivities of a metal wire at temperatures between  $-183^{\circ}$  and  $100^{\circ}$  C. is described. The following values of specific resistance,  $\sigma$ , in ohm cm.  $\times 10^{-6}$ , thermal conductivity,  $\lambda$ , in cal. cm.<sup>-1</sup> sec.<sup>-1</sup>,  $^{\circ}$  C.<sup>-1</sup>, and of the Lorentz coeff. ( $\lambda\sigma/T$ )  $\times 10^8$ , were found for the respective metals at the temperatures ( $^{\circ}$  C.) stated: iron,  $100^{\circ}$ , 15.49, —, —;  $0^{\circ}$ , 9.57, 0.1688, 2.47;  $-78.50^{\circ}$ , 5.74, 0.1710, 2.11;  $-183.00^{\circ}$ , 1.531, 0.224, 1.60; tungsten (single crystal, rectangular section),  $100^{\circ}$ , 7.35, 0.389, 3.20;  $0^{\circ}$ , 4.98, 0.399, 3.04;  $-78.50^{\circ}$ , 3.22, 0.405, 2.80;  $-183.00^{\circ}$ , 0.892, 0.461, 1.91; tungsten (single crystal, hexagonal section),  $100^{\circ}$ , 7.29, 0.390, 3.19;  $0^{\circ}$ , 4.04, 0.405, 3.06;  $-78.50^{\circ}$ , 3.17, 0.425, 2.90;  $-183.00^{\circ}$ , 0.843, 0.511, 2.00; molybdenum,  $100^{\circ}$ , 10.05, —, —;  $100^{\circ}$ , 7.56, 0.329, 2.79;  $0^{\circ}$ , 5.17, 0.329, 2.61;  $-78.50^{\circ}$ , 3.33, 0.329, 2.35;  $-183.00^{\circ}$ , 0.882, 0.430, 1.76; silver,  $100^{\circ}$ , 217.96, 2.863, —, —;  $100^{\circ}$ , 2.123, 0.998, 2.37;  $0^{\circ}$ , 1.510, 0.999, 2.31;  $-78.50^{\circ}$ , 1.035, 1.005, 2.24;  $-183.00^{\circ}$ , 0.341, 1.018, 1.62. The iron was presumably of purity 99.88%; the other metals were extremely pure. A method of determining their purity, by the method of "raies ultimes," is given as an Appendix by C. E. Eddy and T. H. Oddie.—J. S. G. T.

**Elementary Theory of Electronic Semi-Conductors, and Some of their Possible Properties.** R. H. Fowler (*Proc. Roy. Soc.*, 1933, [A], 140, 505-522).—Wilson's theory of semi-conductors is simplified and applied to models representing substances (1) of very small conductivity, (2) with impurities supplying excitable electrons, and (3) with impurities absorbing excited electrons. The equilibrium state, thermionic and photo-electric work functions, contact potential, conductivity, Hall coeff., and thermo-electric power are derived for these models, using as standard of comparison, where necessary, an ideal metal. The occurrence of abnormal signs for the Hall coeff. and thermo-electric power is accounted for.—J. S. G. T.

**The Demonstration of Eddy Currents in Conductors of Various Shapes.** D. Brown (*Proc. Phys. Soc.*, 1933, 45, 555-558).—A simple method is described for demonstrating visually the existence of eddy currents in conductors and of showing how the lines of flow of these currents are distorted by slots or laminations. Essentially, the method comprises laying a sheet of opal glass sprinkled with iron filings on the conductor arranged in the magnetic field of a vertical a.c. electromagnet.—J. S. G. T.

**New Method of Measuring Electric and Magnetic Properties of Metals in the Region of Ultra-Short Electromagnetic Waves.** G. Potapenko and R. Sanger (*Phys. Rev.*, 1933, [ii], 43, 210-211).—Abstract of a paper read before the American Physical Society. In a Lecher system, which consists of two parallel wires and two connecting bridges, the distance between the bridges in the case of resonance does not correspond exactly to the half wave-length. It is always shorter than the half wave-length, the difference being called bridge contraction (Brückenverkürzung) by Drude. Its value depends on the reflecting power of the bridges used and this is affected by the self-induction of the bridges (Drude's theory) and by the resistance of the bridges (exact theory). A plate, the size of which is at least of the order of half of the wave-length, is used as one bridge (the plate bridge, perfectly reflecting). The other bridge consists of wires of different materials and of different diameters (the wire-bridge, poor reflection). Resonance studies make it possible to measure the bridge contraction and the damping of the Lecher system for all kinds of wire used. A theory of the propagation of the waves along the



wires of a Lecher system, taking into account the perceptible resistance of the bridge, is developed. This makes it possible to calculate the value of the resistance of the wire-bridge from the measurement of the bridge contraction and of the damping of the Lecher system. Hence, taking into account the skin-effect and comparing the results for non-magnetic bridges with those for magnetic bridges, or the results for bridges of different diameters, the electrical conductivity and the magnetic susceptibility of the metals of the wire-bridges can be evaluated. The proposed method is checked by preliminary measurements on copper and iron bridges by the use of undamped waves in the region of wave-lengths from 10 to 100 cm.—S. G.

**On a Possible Explanation of Superconductivity.** J. Frenkel (*Phys. Rev.*, 1933, [ii], 43, 907-912).—Theoretical. Previous theories have neglected the electromagnetic inductive forces between the electrons in a metal, and F. shows that, when these are taken into account, an explanation of superconductivity is possible. The picture presented somewhat resembles that of the Lindemann electron-lattice theory; the electrons at very low temperatures move collectively as an organized crowd, and remain undisturbed by the heat motion of the crystal lattice. The transition temperature is the point at which the organized state is destroyed, and the effect of a magnetic field is in general agreement with this point of view.—W. H.-R.

**Change of the Resistance of Metals in a Magnetic Field at Low Temperatures.** W. J. de Haas and P. M. van Alphen (*Proc. K. Akad. Wet. Amsterdam*, 1933, 36, 253-262).—[In English.] Experiments with alloys of copper-zinc, cadmium-mercury, titanium-zirconium, and with pure aluminium and impure cadmium are described. In general, a marked change of resistance goes with high diamagnetism. Impurities have a greater influence at low, than at high, temperatures.—E. S. H.

**Magnetic Properties of Metals at Low Temperatures.** W. J. de Haas and P. M. van Alphen (*Proc. K. Akad. Wet. Amsterdam*, 1933, 36, 263-270).—[In English.] Data are recorded for graphite, copper, zinc, copper-tin alloy (30:70), silver, cadmium, tin, antimony, tellurium, iodine, tungsten, gold, lead, thallium, magnesium, niobium, molybdenum, bismuth, and a copper-tin alloy (Cu<sub>3</sub>Sn) at temperatures down to 14.2° K.—E. S. H.

**Electromotive Forces Associated with Barkhausen Discontinuities.** C. W. Heaps (*Phys. Rev.*, 1933, [ii], 43, 945).—A note. H.'s previous conclusion (*J.*, this volume, p. 342) that discontinuities of resistance are associated with the Barkhausen effect are shown to be untenable, because intrinsic impulsive e.m.f.s are produced in the wire by the Barkhausen discontinuities themselves, and are large enough to mask any effect caused by change of resistance. Indirect evidence that the Barkhausen effect is accompanied by change in resistance is discussed.—W. H.-R.

## II.—PROPERTIES OF ALLOYS

(Continued from pp. 435-440.)

**The Fatigue Properties of Light Metals and Alloys.** R. L. Templin (*Amer. Soc. Test. Mat. Preprint*, 1933, 1-17).—A discussion of various types of fatigue tests suitable for light metals and alloys. A number of machines used for these tests is described. Included in the latter are a direct tension-compression fatigue apparatus and also a high-speed vibrating wire type. Fatigue data for the majority of the important aluminium alloys in both the wrought and cast states, and also for a number of magnesium base alloys are given. The relation between the endurance limit and tensile strength and the effects of cold-working and heat-treatment on the former are discussed. As the elongation is reduced by cold-working notches also were found, to become

more deleterious in their effects on the fatigue strength. The effect of grain-size on the endurance limit is problematical. The necessity for carrying out the tests to a sufficiently large number of cycles is stressed. The number of cycles of stress required to define the endurance limits of most light alloys is of the order of 500 million.—W. A. C. N.

**High-Temperature Tests of Hiduminium.** Anon. (*Met. Ind. (Lond.)*, 1933, 42, 667).—A short note. At temperatures up to 300° C., Hiduminium shows better tensile and hardness properties than "Y" alloys of similar density.—J. H. W.

**Hydronalium, a New Light Alloy.** Anon. (*Automobiltech. Z.*, 1933, 36, 269).—Hydronalium, an aluminium-base alloy of sp. gr. 2.63-2.59, is stated to possess exceptional resistance to corrosion, combined with the following mechanical properties: *As cast*: tensile strength 10.8-16.5 tons/in.<sup>2</sup>, elongation 3-12%; *As forged*: tensile strength 22-28 tons/in.<sup>2</sup>, elongation 22-12%, Brinell hardness 75-95. In contact with alkaline solutions or sea-water, these properties show less deterioration after 48 days' exposure than those of pure aluminium or of Duralumin. Possible applications are enumerated, and some directions for heat-treatment, riveting, and welding are given.—P. M. C. R.

**Bondur and Albondur.** Anon. (*Z. Flugtechnik u. Motor.*, 1933, 24, 209-210).—A summary of Leaflet No. 15 (Dec. 1932) published by the Vereinigte Leichtmetall-Werke, Bonn, describing the physical, mechanical, and anti-corrosive properties of Bondur and its development Albondur.—P. M. C. R.

**Bondur and Albondur.** Anon. (*Maschinenkonstrukteur*, 1933, 66, 91-92).—Bondur is described as an age-hardening alloy of the Duralumin class; the best mechanical properties are obtained by quenching from 500° C. and storing for 5 or 6 days; this period is required to complete the ageing process, which proceeds rapidly for 8 hrs. and then slows considerably. For certain purposes appropriate modifications of the treatment are suggested. Brinell hardness, tensile strength, yield-point, and elongation are shown graphically in relation to quenching temperature; graphs also show the relation of strength and elongation to temperature and to ageing period. For sea-water exposure, a plated Bondur has been developed; the coating may be of aluminium or of some such resistant alloys as K.S.—Seewasser. The mechanical and physical properties of Bondur are tabulated, with notes as to the modifications necessary in the case of plated material. Both Bondur and Albondur are available as sheet, strip, sections, or tubing.—P. M. C. R.

**"Wilmil M"**—An Improved Aluminium-Silicon Alloy Suitable for Stressed Parts. Anon. (*Aluminium Broadcast*, 1933, 4, (9), 15-17).—"Wilmil M" is an aluminium-silicon alloy containing additional alloying elements which impart higher elastic properties and a high fatigue strength. Its principal characteristics are:—

	As Cast.	Tempered.	Fully Heat-treated.
0.1% Proof stress, tons/in. <sup>2</sup> .	4.7	7.0	15.0
Ultimate tensile strength, tons/in. <sup>2</sup>	10.5 to 12.5	11 to 13	16 to 18
Elongation, % on 2 in.	3.0	0.66	0.5
Fatigue strength, tons/in. <sup>2</sup>	3.6	3.6	4.86

—J. C. C.

**Aluminium-Silicon Alloys.—II.** — Broniewski and — Smailowski (*Rev. Mét.*, 1932, 29, 601-604).—Cf. *J.*, this volume, p. 11. Mechanical properties are discussed in relation to modification treatment. Work of other investigators is reviewed briefly. The authors melted their alloys in

an electric furnace, obtaining the desired silicon content by means of a 50% silicon alloy. The tensile and impact properties and microstructure of chill-cast bars in alloys containing 0 to 15% silicon were investigated. Treatment of the molten alloys with titanium tetrachloride (equivalent to 0.1% Ti) had little influence on the mechanical properties of the cast alloys, but some refinement of the structure of the eutectic was observed microscopically. Treatment with alkaline salts was much more beneficial.—H. S.

**Report of Committee A-10 [of A.S.T.M.] on Iron-Chromium, Iron-Chromium-Nickel and Related Alloys.** Jerome Strauss and H. D. Newell (*Amer. Soc. Test. Mat. Preprint*, 1933, 1-2).—Brief details are given of the scope of work of the various sub-committees. It includes classifications of data, chemical analysis, methods of corrosion testing, metallography, welding, and specifications.—W. A. C. N.

**Magnetic Properties of Iron-Cobalt-Tungsten Alloys.** B. A. Rogers (*Metals and Alloys*, 1933, 4, 69-73).—Classification of iron-cobalt-tungsten alloys with 10-30% tungsten into 5 groups has been made from the results of determinations which have been made of the changes which occur in the physical and magnetic properties of the alloys during ageing. Group I contains alloys with 0-20% cobalt and 10-30% tungsten; these behave similarly to binary iron-tungsten alloys having the same tungsten content. Group II comprises alloys with 40-20% cobalt and 10-30% tungsten; these alloys show a peculiar fall in the coercive force at a relatively low temperature when the hardness is at a maximum and the density at a minimum and on further heating their electrical conductivity rises very rapidly within a narrow temperature range. Group III comprises alloys with 60-40% cobalt and 30-10% tungsten; they are relatively non-magnetic after quenching, but become equal to the best cobalt magnet-steels after heat-treatment, although in this state they are not nearly so stable as the cobalt steels. Group IV comprises alloys with around 60% cobalt and 20% tungsten; they are inert towards all heat-treatment. Group V comprises alloys with 90-70% cobalt and 10-30% tungsten with relatively little iron; although these alloys are difficult to obtain in a homogeneous condition, they all show a large increase in hardness on ageing accompanied by a rise in the coercive force and electrical conductivity.—A. R. P.

**Beryllium-Copper: A Copper Alloy that can be Heat-Treated.** Anon. (*Machinery (N. Y.)*, 1933, 39, 733).—The principal properties of beryllium-copper containing 2.5% of beryllium are enumerated.—J. C. C.

**Copper-Cadmium Alloys.** E. A. Owen and Llewelyn Pickup (*Metalurgist (Suppt. to Engineer)*, 1933, 9, 44-45).—A summary and discussion of a paper published in *Proc. Roy. Soc.*, 1933, [A], 139, 526. See *J.*, this vol., p. 189.—R. G.

**Susceptibility and Electrical Conductivity of Cu-Mn Alloys.** S. Valentiner and G. Becker (*Z. Physik*, 1933, 82, 833).—Corrections necessary in the author's previous paper (*ibid.*, 1933, 80, 735) are given. See *J.*, this vol., p. 234.—J. T.

**Tensile Tests Relating to Copper-Nickel Crystals.** E. Osswald (*Z. Physik*, 1933, 83, 55-78).—A method of preparation of single crystals and mixed crystal alloys in a high-frequency electric vacuum furnace is described. The effect of tensile stress on crystal structure and orientation was determined by X-ray methods. Contrary to what was found in the case of nickel, the incidence of slip in single-crystal copper is not characterized by a very definite limiting extension. The curve showing the relation of the limiting extension to the nickel concentration in a series of copper-nickel alloys is complicated, compared with the comparatively simple curve found in the case of the gold-silver alloys. The curve is unsymmetrical, the limiting extension being greater on the nickel side. Nickel appears to be differentiated in this respect from the metals copper, gold, and silver. The slip mechanism characterizing the series of alloys is common to all crystals of the same lattice type hitherto

investigated. The phenomenon of change of hardness due to crystallographic slip follows the same laws as those found for the gold-silver series.—J. T.

**Melting Points of Some Binary and Ternary Copper-Rich Alloys Containing Phosphorus.** W. Earl Lindlief (*Metals and Alloys*, 1933, 4, 85-88).—The equilibria in the copper-phosphorus system up to 12% phosphorus have been re-determined. The eutectic point is placed at 714° C. and 8.38% phosphorus (Heyn and Bauer, *Z. anorg. Chem.*, 1907, 52, 129, found 707° C. and 8.27% phosphorus). The liquidus of hypo-eutectic alloys falls regularly in a smooth curve slightly concave to the axis of composition; the sharp downward bend observed by H. and B. at 6.5% phosphorus has not been confirmed, L.'s figure for the liquidus at this point being 50° C. lower than that of H. and B. The liquidus and eutectic arrests of 18 alloys in the copper-phosphorus-silicon system have been determined; the alloys tested contained 90-96% copper, 2-7% phosphorus, and 1-6% silicon. The liquidus slopes uniformly down from the melting points of the copper-silicon alloys as increasing amounts of phosphorus are added, and a eutectic valley extends across the diagram from the binary copper-phosphorus eutectic and consists of a binary mixture of  $\alpha$ -copper-phosphorus-silicon solid solution and  $\text{Cu}_3\text{P}$  containing silicon in solid solution. The eutectic temperature is raised from 714° to 725° C. by 1% silicon. The liquidus, eutectic arrests and solid transformation temperatures in 37 copper-zinc-phosphorus alloys with 10-50% zinc and 1-10% phosphorus are shown in a table and a partial ternary diagram; the system contains a ternary eutectic at 32.5% zinc, 6% phosphorus, and 690° C. which consists of  $\alpha$ -solid solution,  $\text{Cu}_3\text{P}$ , and a zinc-rich phosphide of undetermined composition. This phosphide has a high melting point, as shown by the rapid rise in the liquidus of alloys containing increasing proportions of it.—A. R. P.

**The U.D.M. Bronzes [Nida; Kuprodur; Kurbus; Aeterna VL-22].** Anon. (*Automobiletech. Z.*, 1933, 36, 166).—Nida-Bronze, a phosphor-bronze containing copper 91-92 and tin 8-9%, is available as drawn tubing. Kuprodur or "Kurbus" (composition not stated) is capable of being worked in the soft condition; subsequent heat-treatment increases the tensile strength to 75 kg./mm.<sup>2</sup> (46.6 tons/in.<sup>2</sup>); dimensions can hence be much reduced. Aeterna VL-22 is recommended as a bearing alloy.—P. M. C. R.

**The Effect of Sulphur and Iron on the Physical Properties of Cast Red Brass (Cu 85, Sn 5, Zn 5, Pb 5).** H. B. Gardner and C. M. Saeger, Jr. (*Amer. Soc. Test. Mat. Preprint*, 1933, 1-11; and (abstract) *Iron Age*, 1933, 132, 22).—The object has been to collect data to be used in the further simplification of the number of typical compositions of copper-base ingot metals. The sulphur content ranged from 0.025 to 0.10%, and the iron from 0.1 to 0.6%. In the former instance casts were made at five temperatures between 1040° and 1260° C. and in the latter at 1065°, 1150°, and 1230° C. Tensile strength, Brinell hardness, electrical resistivity, and density for melts consisting of virgin metal and of remelted metal were compared. The addition of sulphur has less influence in lowering the physical properties of the alloy containing copper 85, zinc 5, tin 5, and lead 5% than increasing the casting temperature. All physical properties of this alloy, other than electrical resistivity, are improved by the addition of iron. Both sulphur and iron appeared to decrease the viscosity of this alloy at casting temperature, but in both cases the shrinkage remained unchanged.—W. A. C. N.

**Relating the Chemical Composition to the Microstructure of a Complex Brass.** Wesley Lambert (*Metallurgia*, 1933, 8, 83-84).—Data are given by which the percentage microstructure of a complex brass of known composition can be determined, within close limits, in the absence of a complementary photomicrograph of a particular alloy. Such data consist of Guillet's "coefficients" for copper and zinc of the various metals contained in a complex alloy, together

with the maximum and minimum limiting figures of the zinc content for each of three groups of brasses and their corresponding structures. With such data the composition of a complex brass containing in addition to copper and zinc, aluminium, manganese, iron, tin, silicon, lead, and nickel, is first reduced to a "copper-zinc" composition from which the microstructure is then calculated.—J. W. D.

**New Alloys of Lead.** Anon. (*South African Engineering*, 1933, 44, 102).—An account of B.N.F. ternary lead alloys Nos. 1 and 2. See this *J.*, 1932, 50, 731.—P. M. C. R.

**The Hall Effect and some other Physical Constants of Alloys. I—The Lead-Bismuth Series of Alloys.** W. Rheinallt Thomas and E. J. Evans (*Phil. Mag.*, 1933, [vii], 16, 329-353).—Values of the resistivities at 0° C., the mean temperature coeff. of resistance between 0° and 30° C. and between -20° and 0° C., the thermo-electric powers, the densities at 16° C., and of the Hall effect in magnetic fields ranging from about 3000 gauss to about 9000 gauss have been determined for a series of 26 alloys ranging from pure lead to pure bismuth. The curves connecting resistivity, temperature coeff. of resistance, thermo-electric power, and density with composition of the alloys have either a well-defined maximum or minimum at a composition depending on the physical property concerned.—J. S. G. T.

**The System Iron-Ferrous Sulphide-Manganese Sulphide-Manganese.** Rudolf Vogel and Hermann Baur (*Arch. Eisenhüttenwesen*, 1932-1933, 6, 495-500; and (in abstract), *Stahl u. Eisen*, 1933, 53, 513).—In the region iron-ferrous sulphide-manganese sulphide-manganese thermal and micrographic investigations on alloys with up to 30% sulphur and 35% manganese have shown that there is a large miscibility gap which closes near the iron corner at 3% sulphur and 6% manganese; at lower temperatures there is a secondary segregation in the iron corner. The sulphur preferentially combines with the manganese and manganese sulphide-iron solid solutions are, in contrast to iron sulphide-iron solid solutions, not brittle, hence their fine distribution around the iron crystallites does not adversely affect the working of the metal.—J. W.

**Are Liquid Sodium Amalgams Colloidal?** Henry E. Bent (*J. Physical Chem.*, 1933, 37, 431-435).—Contrary to the conclusion of Paranjpe and Joshi (see this *J.*, 1932, 50, 663), B. concludes that there is no proof that the properties of pure sodium amalgams are determined by the method of preparation, nor that sodium amalgams are colloidal. The facts (1) that the freezing-point depression of mercury in dilute amalgams is that calculated for an ideal solution; (2) that the lowering of vapour-pressure is that calculated for an ideal solution; (3) that photomicrographs of the solid phases show definite crystalline structure, and (4) that a large amount of heat is liberated during the formation of an amalgam, indicate that the amalgams are true solutions.—J. S. G. T.

**Report of Committee B-4 [of A.S.T.M.] on Electrical-Heating, Electrical-Resistance, and Electric-Furnace Alloys.** Dean Harvey and F. E. Bash (*Amer. Soc. Test. Mat. Preprint*, 1933, 1-6).—Certain revisions in the accelerated life test for metallic materials used in electrical heating are indicated. Minor alterations in the test for thermo-electric power are also recommended. Further progress in connection with chemical analysis, mechanical tests, wrought and cast alloys for high-temperature use, specifications and thermostatic metals—all in relation to the electrical industry—is reported.—W. A. C. N.

**[Illum] A Lasting Alloy for Corrosive Service.** Wayne L. Cockrell (*Refiner Natural Gasoline Manuf.*, 1933, 12, 156-159; *C. Abs.*, 1933, 27, 3434).—The development, production, properties, and applications of Illum are discussed. It consists of nickel 58.40, chromium 21.80, copper 7.95, molybdenum 3.52,

tungsten 2.38, manganese 1.72, silicon 0.70, iron 3.10, and carbon 0.32%. It has a tensile strength of 60,000 lb./in.<sup>2</sup>, a Brinell hardness of 170–200, a coeff. of expansion per degree of 0.0000135, melting point 1300° C., sp. gr., 8.3, specific heat 0.105 cal./degree, electrical resistance 121.9 microhm, and machinability comparable to that of cast steel. In boiling 25% sulphuric acid or 25% nitric acid solution Illium should not lose more than 40 mg./cm.<sup>2</sup> in 24 hrs. Hot sulphur dioxide gas at 1800° F. (982° C.) has no effect. Wet chlorine atmosphere has no action on the alloy.—S. G.

**Illium.** Anon. (*Met. Ind. (Lond.)*, 1933, 43, 38).—*Cf. J.*, this volume, pp. 125, 301. Illium is an alloy containing nickel 60.5–62.5, chromium 21.0, copper 6.5, molybdenum 4.7–5.0, tungsten 2.0, manganese, silicon, aluminium, and iron each 1.0%, and small quantities of titanium, boron, and carbon. Its chief use is in the production of thermo-elements but it also derives applications from its resistance to nitric acid.—J. H. W.

**Properties of the Alloys of Nickel with Tantalum.** Eric Therkelsen (*Metals and Alloys*, 1933, 4, 105–108).—With up to 36% tantalum nickel-tantalum alloys consist of a homogeneous solid solution, the liquidus and solidus falling uniformly from 1453° to 1350° C. with only a narrow gap between them. The liquidus then rises to a flat maximum at 1543° C. and 50.7% tantalum corresponding with Ni<sub>3</sub>Ta, and again falls to 1400° C. with 60.7% tantalum, after which it rises sharply to the melting point of tantalum. In the solid state there is a narrow β-field around Ni<sub>3</sub>Ta; the α solid solution extends to 41% tantalum at 1350° C., but only to about 36% tantalum at 600° C., so that alloys with 36–41% tantalum are amenable to precipitation-hardening. There is a complex heterogeneous region in the solid state between 60.7 and 77% tantalum; at 1350° C. alloys with 52–75% tantalum undergo a transformation associated with the separation of long white needles from β, followed by decomposition of most of the remaining β with the separation of rounded crystals. Alloys with up to 35% tantalum are malleable and ductile, whereas those with more tantalum are hard and brittle, especially the 60.7% tantalum alloy. The resistivity of the 9% tantalum alloy between 0° and 180° C. is 0.262 (1 + 2 × 10<sup>-3t</sup> + 1.6 × 10<sup>-6t<sup>2</sup></sup>) ohms/m.mm.<sup>2</sup>; the resistance to corrosion of the alloys is good, especially at 12.5 atomic-% tantalum.

—A. R. P.

**Platinum-Cadmium Alloys.** K. W. Ray (*Proc. Iowa Acad. Sci.*, 1931, 38, 166; *C. Abs.*, 1933, 27, 1852).—Platinum-cadmium alloys containing as much as 50% platinum were prepared by heating the two metals together. Solid platinum dissolves in hot molten cadmium to form a series of alloys, which have relatively low melting points. The thermal diagram of a portion of the system was investigated by means of thermal analysis, microscopic study and X-ray examination. Two intermetallic compounds are formed, Pt<sub>2</sub>Cd<sub>2</sub> and PtCd<sub>2</sub>. Pt<sub>2</sub>Cd<sub>2</sub> decomposes at 615° C. into cadmium and PtCd<sub>2</sub>. PtCd<sub>2</sub> melts at 725° C. Pt<sub>2</sub>Cd<sub>2</sub> and cadmium form a eutectic at 2% cadmium, which melts at 315° C. All platinum-cadmium alloys having more than about 6% platinum are very brittle and are much harder than either platinum or cadmium. Alloys containing as much as 35% platinum are exceedingly brittle and have a hardness nearly equal to that of hardened steel. The alloys are white and dissolve in hydrochloric acid or sulphuric acid to form the corresponding cadmium salts. The platinum is left undissolved as black sponge. The cadmium volatilizes rapidly when attempts are made to form alloys containing more than 50% platinum, and a pasty mass is obtained which cannot be melted except under pressure.—S. G.

[**The Constitution of] the Alloys of Platinum with Cobalt.** W. A. Nemilow (*Z. anorg. Chem.*, 1933, 213, 283–291).—[*Note by Abstractor.*—Concentrations are given in atomic-% platinum.] The liquidus has been determined between 0 and 50%; it has a very flat minimum at 20–30% and 1467° C. The

constitution of solid alloys has been studied by microscopic investigations and measurements of Brinell hardness after slow cooling from 900° C. (alloys with 0-92%) and after quenching at 500° C. and 1200° C. (alloys with 0-41%). At 1200° C. a continuous series of solid solutions exists. Between 1200° and 500° C. in alloys with up to about 30%, a transformation of still unknown nature takes place characterized by a breakdown of the large solid solution crystals into very small crystallites. The hardness-concentration curve of the slowly cooled alloys has two maxima at about 12 and 50% and a relative minimum at 20-25%. The existence of platinum-rich solid solutions was confirmed by electrical resistance measurements with alloys between 80 and 100%.—M. H.

**Nature of the Solid Solution of Aluminium in Silver.** C. S. Barrett (*Metals and Alloys*, 1933, 44, 63-64, 74).—The lattice parameter of silver is reduced linearly by 0.0012 Å. and the density by 0.069% for every 1 atomic-% of aluminium that is present in solid solution; hence it is concluded that the solid solution of aluminium in silver is of the simple substitutional type.

—A. R. P.

**Equilibrium Diagrams of Binary Alkali Metal Alloys. The Sodium-Potassium Alloys.** E. Rinck (*Compt. rend.*, 1933, 197, 49-51).—Special apparatus which enables the molten alkali metals to be manipulated out of contact with air has been devised and used to construct the sodium-potassium equilibrium diagram. An unstable compound, Na<sub>2</sub>K, and a eutectic containing 66 atomic-% of potassium are shown to exist. The reaction resulting in the formation of the compound is never complete, and is shown on the diagram by a horizontal line at -12.5° C., the solidification temperature of the eutectic. The results obtained with these alloys agree completely with those of van Bleiswijk.—J. H. W.

**The Effect of the Addition of Lead on the Hardness of Certain Tin-Base Bearing Alloys at Elevated Temperatures.** J. N. Kenyon (*Amer. Soc. Test. Mat. Preprint*, 1933, 1-15; and (abstract) *Iron Age*, 1933, 132, 22).—For temperatures up to 100° C. the addition of 3-4% lead to 3 tin-base alloys increases their hardness, and even up to the melting point of the tin-lead eutectic (183° C.) there is no appreciable falling off in hardness. Hardness-temperature curves for tin-base alloys are parabolic, and when the values are plotted logarithmically the hardness of these materials at higher temperatures can be reasonably predicted. In the hardness determinations greater accuracy was attained by using a load which did not cause "cratering" of the Brinell impression. The paper contains an interesting survey of previous work on correlated subjects, and also a *bibliography*.—W. A. C. N.

**A Comparison of Certain White-Metal Bearing Alloys Particularly at Elevated Temperatures.** C. E. Swartz and A. J. Phillis (*Amer. Soc. Test. Mat. Preprint*, 1933, 1-10; and (abstract) *Iron Age*, 1933, 132, 22).—The physical properties of certain tin-base and cadmium-base bearing alloys, at temperatures up to 300° C., have been studied. The cadmium alloys showed better qualities than the tin-base materials. The former were particularly impressive at higher temperatures owing to the higher range of the solidus. The cadmium alloys are also harder and less brittle than those containing tin. Tests on a practical scale on a six-cylinder motor unit confirmed the results of the laboratory tests. Creep tests indicate a much higher order of creep resistance in the cadmium-nickel alloy than in the tin alloy. The former alloy readily bonds itself to steel, brass, and bronze, and can be used with advantage in many installations.—W. A. C. N.

**Ageing of Metals after Cold-Working by Applied Tension.** J. Galibourg (*Rev. Mét.*, 1933, 30, 96-111).—Stress-strain diagrams of steel wire are studied in relation to overstrain in tension followed by ageing. Diagrams for freshly-drawn wire which has undergone 10% reduction since being

annealed show no defined elastic limit. Immediate ageing at 160°–170° C. causes the appearance of an elastic limit. Overstrain in tension followed by ageing at 160°–170° C. shows a very marked horizontal below which the curve is rectilinear. Ageing for 70 days at 15° C. straightens out the curve somewhat, the effect being less accentuated than that of ageing at 160°–170° C., and supplementary ageing at 160°–170° C. raises the elastic limit, causing the occurrence of a short horizontal portion. In more heavily drawn wires an elastic limit is observed after similar treatments but the horizontal is not seen even after elevated ageing. Similar experiments with pure nickel indicated that drawn nickel wire has a lower elastic limit than annealed nickel, as was also the case with steel wire. The principal features of tests of steel wires at elevated temperatures are described.—H. S.

**Inverse Segregation.**—II. H. Sutton (*Metallurgist* (Suppt. to *Engineer*), 1933, 9, 35–36).—Cf. *J.*, this volume, p. 350. A continuation of the review of present knowledge of the subject, summarizing the recent work of Haase on copper–zinc alloys, of Masing and Overlach on antimony–bismuth alloys, and of Watson on silver–copper alloys. An alternative explanation of Watson's results is put forward to correlate them with those of other workers.

—R. G.

**Solubility of Hydrogen in Some Metals and Alloys.** Lothar Luckenmeyer-Hasse and Hermann Schenck (*Arch. Eisenhüttenwesen*, 1932–1933, 6, 209–214; and (abstract) *Stahl u. Eisen*, 1932, 52, 1178).—The solubility of hydrogen at atm. pressure in iron, chromium, nickel, and manganese and in certain of their alloys has been determined at temperatures up to 1200° C. (1500° C. for iron). The solubility in manganese increases suddenly in the transition from  $\alpha$  to  $\beta$  and again in the transition from  $\beta$  to  $\gamma$ ; the solubility in nickel–iron alloys is greater than in iron but it is less than in pure iron in  $\alpha$ -chromium–iron alloys and slightly greater in  $\gamma$ -chromium–iron alloys with 5–15% chromium.—J. W.

**On the Physics of Polymorphic and Magnetic Transformations.** Heinrich Lange (*Z. tech. Physik*, 1933, 14, 226–229).—A short review of various types of transformations in metallic systems—polymorphic, magnetic, and superstructure—and on modern ideas of their mechanism discussed chiefly with the austenite–martensite transformation as an example.—J. W.

**The Magnetic Susceptibility of Metallic Solid Solutions and Some Binary Alloys** [Au–Ag, Au–Cu, Sb–Bi, Pt–Pd, Sn–Bi, Bi–Pb, Cd–Sn, Sb–Pb, Bi–Te, Al–Sn]. Yosomatsu Shimizu (*Kinzoku no Kenkyu*, 1933, 10, (2), 49–62).—[In Japanese.] See abstract from English source, *J.*, this volume, p. 186.—S. G.

**On the Equilibrium Diagrams of Quaternary Systems.**—I. Shuzo Takeda (*Kinzoku no Kenkyu*, 1933, 10, (2), 71–90).—[In Japanese.] Based on the gravity relation of heterogeneous equilibrium, the quaternary system is discussed graphically, and the construction of equilibrium diagrams (isothermal diagram, general diagrams, concentration–temperature space model, projection diagram, sectional diagram) of a simple eutectic type and a method for their determination are explained.—S. G.

**On the Equilibrium Diagrams of Quaternary Systems.**—H. Shuzo Takeda (*Kinzoku no Kenkyu*, 1933, 10, (3), 91–102).—[In Japanese.] The case in which a binary peritectic compound is formed is dealt with. A binary peritectic compound gives rise to a peritecto–eutectic reaction in a ternary system, and a peritecto–ternary eutectic reaction in a quaternary system, i.e. a non-variant reaction in which a liquid phase and a solid phase act together, forming 3 solid phases.—S. G.

**The Basic Principles of Metallurgical Reactions.** Willy Ölsen (*Z. tech. Physik*, 1933, 14, 222–226).—A summary of recent theoretical and experimental work on the equilibria between metal and slag (cf. *J.*, this volume, p. 75).—J. W.



## III.—STRUCTURE

(Metallography; Macrography; Crystal Structure.)

(Continued from pp. 440-441.)

**Polishing and Etching of Constituents of Aluminium Alloys.** F. Keller and G. W. Wilcox (*Metal Progress*, 1933, 23, (4), 45-46, with attached chart; (5), pp. 38, 40, 42, 44, 46, 48, 50).—(I.—) A general classification of the nature of constituents occurring in aluminium alloys is followed by directions for polishing and by a test of common etching reagents, with concentrations, etching temperatures, and methods of application and washing. The compositions of the alloys used in preparing a forthcoming series of illustrations are given. (II.—) Seven sheets of photomicrographs are given, showing characteristic constituents, etched by various methods, at a standard magnification of 500 diam.—P. M. C. R.

**X-Ray Investigation of the Solid Solubility of Aluminium in Copper.** J. Obinata and G. Wassermann (*Naturwiss.*, 1933, 21, 382-385).—A redetermination of the solubility of aluminium in solid copper at various temperatures by the X-ray method has substantially confirmed the results obtained micrographically by Stockdale. The solubility appears to remain constant below 650° C. Homogeneous single crystals of alloys with 3, 5, and 8% aluminium obtained by slow solidification have the same lattice constants as cast or recrystallized specimens of the same composition.—J. W.

**Eutectoid Transformation of Bronze.** Gunji Shinoda (*Suiyokai-shi*, 1932, 7, 367-372; *C. Abs.*, 1933, 27, 2123).—[In Japanese.] Bronzes containing 22.38 and 25.70% tin (I and II, respectively) were quenched from 650° C., and their internal structures were investigated by means of  $CuK\alpha$  X-rays. The  $\beta$ -phases have body-centred cubic lattices of 2.973 Å. for (I) and 2.981 Å. for (II). These  $\beta$ -phases are transformed, by tempering, into  $\beta'$ -phases, which are then decomposed into  $\alpha$ - and  $\delta$ -like phases. Alloy (I) quenched from 730° C. had a body-centred lattice with  $\alpha = 2.889$  Å. and  $c/a = 1.059$ .—S. G.

**An X-Ray Investigation of the Gold-Rhodium and Silver-Rhodium Alloys.** Roy W. Drier and Harold L. Walker (*Phil. Mag.*, 1933, [vii], 16, 294-298).—The gold-rhodium series of alloys was found to be one of two solid solutions. The maximum contraction of the gold lattice due to solution of rhodium amounts to 0.011 Å., which indicates a solubility of 4.1% (atomic) of rhodium in gold. Limiting spectra and consideration of Westgren's and Almin's results indicate that a better value of this solubility would be nearer 8% (atomic). The edge of the unit cell of rhodium expands in the alloys by as much as 0.003 Å. The solubility of gold in rhodium lies between 1.1% (atomic) and 2.5% (atomic); a possible value is 1.5% (atomic). The inter-solubility of silver and rhodium could not be detected, but it is considered probable that these metals are at least minutely soluble in each other and that the system of alloys is one of two exceedingly limited solid solutions.—J. T.

**Zone-Like Structure of Electrolytically Deposited Nickel Films.** W. G. Burgers and W. Elenbaas (*Naturwiss.*, 1933, 21, 465).—The orientation of the crystallites of electrolytically deposited metal films is dependent on the conditions of deposition. In the case of nickel the [100]- or [110]-, and occasionally the [113]-planes are in the direction of the current lines. This regular orientation frequently remains throughout the deposit, or it may form a complex fibrous structure. Different textures may appear in zones on top of one another in the same film, and no generally applicable conclusions can be reached as to the orientation which will be obtained under given conditions.—J. W.

**Detection of Lattice Distortion by X-Rays.** B. Pfarr (*Z. tech. Physik*, 1933, 14, 220-221).—The known changes which occur in the sharpness of the ultimate interference lines in X-ray spectrograms during cold deformation, annealing, and hot deformation have been confirmed by photometric measurements of the breadth of the lines. In hot deformation the degree of distortion is not a simple function of the sharpness of the lines, since the effects of deformation and recrystallization may mask one another in different ways.

—J. W.

**Statistical Mechanics with Particular Reference to the Vapour Pressures and Entropies of Crystals.** R. H. Fowler and T. E. Sterne (*Rev. Modern Physics*, 1932, 4, (4), 635-722).—Theoretical. A general development of the theory of "chemical constants" is given, part being based on Fowler's "Statistical Mechanics," and the remainder being previously unpublished. The validity of Nernst's Heat Theorem is discussed, and it is concluded that the theorem is not universally true, or at least not when applied straightforwardly to the data of the practical physical chemist. The term "chemical constant" is therefore discarded, and the name "vapour-pressure constant" used for the constant appearing in the vapour-pressure equation. The paper contains *inter alia*: Chapter I. Introduction to the Study of the Vapour Pressures and Entropies of Crystals; Chapter II. Quantum Statistical Mechanics and the Vapour Pressure Constants of Monatomic Vapours. This includes data for the vapour-pressure constants of mercury, cadmium, zinc, lead, sodium, and potassium; Chapter IV and Appendices I and II. Applications of Quantum Mechanics to Crystals; Chapter VII. Mixed Crystals; Chapter IX. Entropies and Chemical Equilibria. An index of authors and subjects is included.—W. H.-R.

**Magnetic Quadrupole Field and Energy in Cubic and Hexagonal Crystals.** L. W. McKeehan (*Phys. Rev.*, 1933, [ii], 44, 38-42).—Theoretical. In crystal-line arrays of equal and co-directed ideal bar magnets or circular Ampèrian current loops the magnetic field at certain points, and the magnetic potential energy of the array depend, if the linear dimensions of the magnetic elements are small in comparison with the distance between them, on a series of terms, the first of which would be due to a similar array of dipoles. The second term in the series is called the quadrupole term, and is calculated for simple cubic, face-centred and body-centred cubic, diamond type, simple hexagonal, and hexagonal close-packed arrays. McK. points out and corrects errors in the calculations of Peddie (*Proc. Roy. Soc. Edinburgh*, 1912, 32, 216), Forrest (*Trans. Roy. Soc. Edinburgh*, 1926, 54, 601), and Mahajani (*Proc. Camb. Phil. Soc.*, 1926, 23, 136; *Phil. Trans. Roy. Soc.*, 1929, [A], 228, 63).—W. H.-R.

**A Method of Taking X-Ray Photographs of Crystalline Powder at the Temperature of Liquid Air.** J. A. Santos and J. West (*J. Sci. Instruments*, 1933, 10, 219-221).—A Debye-Scherrer camera for taking X-ray photographs of powdered crystals at the temperature of liquid air is described. The specimen is contained in a thin-walled glass tube which is made to rotate about, and to oscillate along, a vertical axis under conditions in which the tube is submitted to a continual stream of liquid air. The vortical travel causes the specimen periodically to enter a tube full of liquid air, and thus ensures a constant temperature. A scale diagram is included.—W. H.-R.

## IV.—CORROSION

(Continued from pp. 442-443.)

**The Influence of Heat-Treatment on the Corrosion of Rolled Light Alloys.** Anon. (*Z. Flugtech. u. Motor.*, 1933, 24, 284-285).—The heat-treatment designed to give the maximum improvement in mechanical properties does not necessarily coincide with that best suited to develop resistance to corrosion. Time and temperature of age-hardening and of annealing, and quenching temperature and speed, have been shown to affect anti-corrosive properties. The work of H. Mann (*Korrosion u. Metallschutz*, 1933, 9, 141-150, 169-178) has been supplemented by that of Rawdon and Meissner, on Duralumin 681B and on magnesium-free Lantal ULW14. The influence of annealing temperature and of accelerated ageing have been investigated, and optimum conditions for these treatments established for the alloys in question.—P. M. C. R.

**Duralplat, a Corrosion-Resisting Light Alloy of High Strength.** K. L. Meissner (*Maschinenkonstrukteur*, 1933, 66, 88-90).—An account of extended sea-water corrosion tests on Duralplat (for earlier work see this *J.*, 1932, 49, 135-145). The investigation took the following forms: (1) examination of the surface condition of test-pieces after cleaning and/or removal of marine growths; (2) estimation of loss of weight. M. considers this method fruitful only in the case of plated specimens, on which attack is evenly distributed; it is valueless for unplated alloys of types susceptible to intercrystalline corrosion, which show grave deterioration in properties, while suffering little or no loss of weight; (3) mechanical testing, the principal properties tested being yield-point, tensile strength, and elongation; (4) microscopic examination. The effects of exposure on sheets and sections plated to various thicknesses are discussed, and exposure times are plotted against yield-point, elongation, and tensile strength.—P. M. C. R.

**Resistance to Sea-Water Corrosion of Certain Aluminium-Magnesium Alloys.** E. Herzog and G. Chaudron (*Compt. rend.*, 1933, 196, 2002-2003).—Pinhole and intercrystalline corrosion in natural sea-water have been investigated by (a) anodic attack for 4 days; (b) attack under pressure of oxygen for 8 days, and (c) alternate immersion and emersion for 5 months. It was found that quenching and tempering alloys containing magnesium and silicon causes precipitation of  $Mg_2Si$  and renders the alloys particularly susceptible to intercrystalline corrosion. Manganese prevents this. Copper causes pinhole corrosion. Hence copper and silicon should be absent and the mechanical properties retained by adding extra magnesium. Alloys consisting of pure aluminium and magnesium can be rolled at about 400° C. For an alloy containing 6% magnesium and less than 0.15% silicon, after annealing at 450° C., the breaking stress was 30 kg./mm.<sup>2</sup> (19 tons/in.<sup>2</sup>) and the elongation 28%; for an alloy containing 9.5% magnesium and 0.2% silicon, after quenching in air from 420° C., they were 38 kg./mm.<sup>2</sup> (24 tons/in.<sup>2</sup>) and 30%, respectively.—J. H. W.

**The Corrosion of Brass. The Structure of the Corroded Surface.** Charles W. Stillwell and Edward S. Turnipseed (*Physics*, 1933, 4, 263).—X-ray analysis indicates that  $\epsilon$ -brass, etched by 2N-16N nitric acid, is dissolved as such. The only corrosion layer is a thin layer of copper probably redeposited by displacement. When  $\epsilon$ -brass is etched in N sulphuric acid the layer is copper after a short etch. With increase of etching time (up to 1 hr.)  $\beta$ - and then  $\gamma$ -brass are found beneath the copper. The  $\gamma$ -brass is most concentrated next to the unetched  $\epsilon$ -brass base; the outside layer is copper and between is  $\beta$ -brass. When  $\epsilon$ -brass is etched in acetic acid, the zinc is dissolved and the first corrosion layer is  $\gamma$ -brass. These results agree with the conclusions reached by Graf relating to the corrosion of copper-gold alloys by strong and weak acids.—J. S. G. T.

**The Corrosion and Protection of Condenser Tubes.** M. Varinois (*Caoutchouc & Gutta-percha*, 1933, 30, 16272-16274; *C. Abs.*, 1933, 27, 1602).—A discussion of the different kinds of corrosion.—S. G.

**Corrosion of Lead Cable Sheaths.** T. Kyōgogu (*J. Inst. Elect. Eng. Japan*, 1932, 52, 59-60; *Sci. Abs.*, 1932, [B], 35, 512).—In order to facilitate research on this problem, K. developed two indicators which show by a colour change the corroded zone on a lead sheath caused by residual mechanical stress or other physical heterogeneities when the sample is immersed in an electrolyte. In addition, the change of single potential of a lead bar was measured when various loads were applied or removed from one end. These methods have been of value in the investigation of the mode of corrosion of buried lead-sheathed cables, especially at points where they are liable to be subjected to mechanical stress.—S. G.

**Remarks on the Study of the Corrosion of Metals and the Corrosion of Different Alloys of Magnesium.** A. Portevin, P. Bastien, and M. Benoit (*Compt. rend.*, 1933, 196, 1999-2002).—In order to obtain a comparable standard of the rate of corrosion in the case of simple solution, the gas evolved when a sufficiently rapid current of the liquid passes coaxial cylindrical specimen is measured. The curve representing the rate of corrosion, thus defined, is a straight line when the velocity exceeds 4.6 m./minute. Should the curve not be rectilinear, it is an indication of a more complex phenomenon such as passivity or polarization. In the case of the magnesium-rich magnesium-aluminium-copper alloys, the addition of aluminium diminishes the rate of corrosion in dilute hydrochloric acid and salt ( $MgCl_2$ ) solutions, until the second constituent appears. In the case of the magnesium-copper-silicon alloys, the curve is not a straight line, owing to autoprotection by the compound  $Mg_2Si$ . Thus the addition of aluminium to a magnesium alloy diminishes the rate of corrosion initially and then increases it, whilst silicon increases it initially and then diminishes it.—J. H. W.

**Report of Committee B-3 [of A.S.T.M.] on Corrosion of Non-Ferrous Metals and Alloys.** T. S. Fuller and Sam Tour (*Amer. Soc. Test. Mat. Preprint*, 1933, 1-2).—Progress reports on the work of Sub-Committees dealing with the following subjects—atmospheric corrosion (see abstract below), corrosion in liquids, and galvanic electrolytic corrosion.—W. A. C. N.

**Report of Sub-Committee VI [of Committee B-3 of A.S.T.M.] on Atmospheric Corrosion of Non-Ferrous Metals and Alloys.** William H. Finkeldey (*Amer. Soc. Test. Mat. Preprint*, 1933, 3-20).—Appendix to Report of Committee B-3 (preceding abstract). The results of atmospheric corrosion tests on 24 non-ferrous metals and alloys following exposure at 9 stations showing widely variant atmospheric conditions. The extent of corrosion was measured by one or more of the following methods: (1) change in weight; (2) change in tensile strength and percentage elongation; (3) visual examination of the amount and character of the surface films produced. The methods of carrying out these tests are described and discussed. In the tension tests comparison pieces which had suffered no corrosion were used as standards. Account had also to be taken of possible ageing effects where extreme temperatures were met. Generally speaking, corrosion results in marked surface roughening of the specimens leading to the "notch effect" or stress concentrations and resulting localization of deformation. This induces a reduction in elongation and tensile strength. These spots are especially noticeable in the early days of a corrosion test. The thickness of the specimen sheet is of major importance. A table of the average meteorological conditions at the various stations is included.—W. A. C. N.

**Experiments on the Corrosion of Metals in Mayonnaise Plants. Results of Tests Made in Plants under Actual Operating Conditions.** F. L. Laque (*Spice Mill*, 1932, 55, 1414-1416, 1421; *C. Abs.*, 1933, 27, 1602).—The

corrosion tests indicate that Inco Chrome-Nickel (nickel 81, chromium 13, and iron 6%) and 18 : 8 chromium-nickel-iron alloy are the most appropriate for general use in mayonnaise plants.—S. G.

**Testing the Resistance of Metals Under the Conditions of Carbon Tetrachloride Production.** L. Vernitz and A. Kudinova (*Trans. State Inst. Appl. Chem. (Leningrad)*, No. 15, 1932, 39-43; *C. Abs.*, 1933, 27, 2919).—The action of dry and wet liquid and gaseous carbon tetrachloride, sulphur chloride, and sulphur bichloride and their mixtures on lead, iron, cast-iron, nickel, brass, copper, silver, aluminium, and chrome iron was investigated. Aluminium and copper do not resist the action of sulphur chloride, chrome iron resists dry sulphur chloride and sulphur bichloride, but not the mixture of hydrochloric acid and dry sulphur chloride. Nickel is very resistant and lead comparatively resistant.—S. G.

**Corrosion in Non-Pressure Refining Equipment.** S. S. Shaffer and J. E. Pollock (*Proc. Amer. Petrol. Inst.*, 1932, (III), 63-70; and *Refiner and Natural Gasoline Manuf.*, 1932, 11, 568; *C. Abs.*, 1933, 27, 2023).—Corrosion in storage tanks, pipe lines, atmospheric stills and columns, and condensers is discussed, and the quantity of ammonia gas needed to combat corrosion is given.—S. G.

**Fuel Problems [Section on Corrosion by Alcohol].** C. O. Ostwald (*Automobiletech. Z.*, 1933, 36, 157-158).—Concluding portion only of a contribution to a discussion on fuel problems held at the Berliner Automobilklub, Sept. 8, 1932. A case of apparently complete corrosion of brass sheeting from a fuel tank is cited. The "failure," attributed to corrosion by alcohol fuel, was only apparent, a thick brownish-green deposit actually protecting the sound material below. O. considers that many such cases exist, and further that erosion due to small amounts of grit and other impurities is frequently attributed to corrosion by alcohol fuels. An apparatus for carrying out comparative corrosion tests is illustrated and described. O. states that the hydrocarbons and combustion products of benzol attack ordinary structural materials more vigorously than do the products of the pure alcohol used in fuels; these in some cases lessen the liability to corrosion.—P. M. C. R.

**Acid Treatment for Increasing Oil Production.** R. B. Newcombe (*Oil Weekly*, 1933, 69, (11)).—The development of the treatment is traced, and the type of acid now in general use is described. Aqueous hydrochloric acid, of concentration from 5 to 20%, is employed; its corrosive action on iron, steel, and copper is very largely inhibited by the addition of certain inhibiting agents. Arsenious oxide is frequently used; other chemical inhibitors are sometimes substituted for it. Other methods are: the introduction of a "blanket" or non-reactive body before the acid, the effects of which are confined to the productive zones, where the paraffins themselves largely protect the metal; the use of a brine seal, or a material forming a gel with salt water and inhibiting the action of the acid; a surface-tension breaker which allows the calcium chloride formed in the reaction to leave the rock and minimize acid corrosion.—P. M. C. R.

**Ricardo Has New Theory to Explain Concentrated Wear of Cylinder Bore.** Anon. (*Automotive Ind.*, 1933, 68, (14)).—H. C. Ricardo considers that much of the loss of metal from cylinder liners is explained by direct corrosion by products of partial combustion. A discussion of the probable mechanism of the process is followed by an explanation of failure in big-end white-metal linings.—P. M. C. R.

**Rapid Detection of Rates of Corrosion with Simplified Apparatus.** Cloyd M. Chapman (*Water Works and Sewerage*, 1932, 79, 282-284; *U.S. Public Health Abs.*, 1932, 12, W, 139; *C. Abs.*, 1933, 27, 1602).—Preparation of the surface of corrosion test-specimens of metals and alloys by pre-test polishing to a sufficient degree to permit microscopic detection of the character and progress of the corrosive attack offers a means for making rapid determina-

tions of the relative suitability of the material to resist corrosion. The test is very delicate, as indicated by the fact that exposure for only a few hours may be sufficient to indicate a difference in the extent of corrosion produced by minor differences in the quantities of corrosive elements present.—S. G.

**A Sensitive Method of Measuring Corrosion.** W. E. Campbell (*Bell Laboratories Record*, 1933, 11, 333-338).—By measuring the electrical resistance of a wire, it is possible to follow the progress of corrosion in reducing its cross-sectional area. Details are given of the application of the method to the study of the corrosion of lead wires when exposed to the vapours from moistened sawdust, to the corrosion of metals when maintained at a potential in respect to various insulating materials with which they are in contact in a humid atmosphere, and to the corrosion of metals in contact with oils and organic acids.—J. C. C.

**Endurance of Metal in Corrosive Surroundings.** T. S. Fuller (*Metal Progress*, 1933, 23, (6), 23-26).—A rotating beam machine for making endurance tests on metals in controlled environment is described and illustrated, and the methods of use and of recording results are described. The history of the investigation of "corrosion-fatigue" is briefly summarized, with special reference to the work of McAdam; the results of later work (on steel) are tabulated and discussed.—P. M. C. R.

## V.—PROTECTION

(Other than Electrodeposition.)

(Continued from pp. 443-445.)

**Protective Coating for Aluminium.** Anon. (*Indian Eng.*, 1933, 93, 329).—An account of a coating, said to be identical with corundum both in composition and in hardness, which can be produced on aluminium in various colours. Lacquering is said to be unnecessary, and the product is stated to be non-porous.—P. M. C. R.

**The Tarnishing of Silver and Means for Prevention.** H. Reinhardt (*Oberflächentechnik*, 1933, 10, 93-94).—The causes of tarnishing of silver ware are described and a brief account is given of the various methods which have been proposed to prevent it. These include lacquering, plating with chromium, palladium, rhodium, or platinum, alloying with cadmium (a large proportion is necessary to afford sufficient protection), and a new process in which the metal is dipped for 1 minute in a solution containing 0.5 gm./l. of chromic acid, potassium persulphate, or copper ammonium chloride.—A. P.

**Aluminium Coating: the Alumilite Process.** Anon. (*Indust. Australian*, 1933, 88, 144).—The Alumilite coating process is briefly described, and the resistant and yet elastic quality of the protective film is emphasized.—P. R.

**Tinning and Galvanizing.** T. Aizawa, G. Wachi, and T. Ebihara (*Res. Electrotech. Lab. Tokyo*, No. 333, 1932, 1-19; *Sci. Abs.*, 1932, [B], 35, 699).—[In Japanese, with English abstract.] Describes an investigation of the tin or zinc coating of telephone and telegraph wires. In the case of tinning, the diffusion of copper in the molten tin is discussed and the structure of the tin coating is explained with respect to the copper-tin equilibrium diagram. The effects of the addition of a small percentage of cadmium, magnesium, aluminium, zinc, lead, antimony, and bismuth on the chemical and mechanical properties of a tin coating are given. The formation of alloy layers due to the diffusion of copper into the tin coating is immaterial because these layers withstand the action of sulphur fairly well. The cause of failure of the tin coating is the improper handling of the wire in the course of the rubber insulation. A small quantity of cadmium in the tin increases the hardness and the ability to resist the action of sulphur, but it makes the tinning

operation more difficult. In the case of hot-galvanizing, the relation between the cracking and peeling off of a zinc coating on a galvanized iron wire and the thickness of the alloy layer of  $\text{FeZn}_2$  and  $\text{FeZn}_3$ , and also the effect of added elements such as aluminium, nickel, tin, copper, antimony, and cadmium on the growth of the alloy layer and on the corrosion properties are dealt with. The growth of the compound layer of  $\text{FeZn}_3$  should be limited in order to prevent cracking of the coating; the addition of 0.5-1.0% aluminium was found to be most effective in preventing cracking. No appreciable difference was found in the corrosion test between pure zinc and zinc containing small quantities of various elements.—S. G.

**Tin as a Metal Addition to Hot-Dip Galvanizing Baths.** Wallace G. Imhoff (*Amer. Metal Market*, 1932, 39, (232), 5; (233), 5, 8; (234), 4, 10; (235), 5, 8; (236), 5, 8; *C. Abs.*, 1933, 27, 694).—The use of tin in hot-dip galvanizing is discussed from several different angles, including the factors affecting the amount to be added, its thinning and cleansing effect, &c. Adherence is increased and the tendency to tarnish decreased. It is considered probable, however, that the formation of "white rust" is accelerated by the addition of tin. It is concluded that small additions of tin between 0.1 and 0.3% are beneficial to zinc coatings under certain conditions.—S. G.

**Production and Use of Galvanized Roofing Sheets.** G. C. Bartells and K. J. T. Ekblaw (*Agricultural Eng.*, 1932, 13, 47-50; *C. Abs.*, 1933, 27, 3428).—The galvanizing of the sheets and the relation between the thickness of the zinc coating and the resistance to rusting are discussed. In actual use, sheets coated with zinc at the rate of 1.6-2.2 oz./ft.<sup>2</sup> showed little or no signs of rust in 10-25 years, whereas those coated at the rate of 0.8-1.2 oz./ft.<sup>2</sup> showed considerable rusting in 3-11 years.—S. G.

**Report of Sectional Committee [of A.S.T.M.] on Zinc Coating of Iron and Steel.** J. A. Capp and A. B. Campbell (*Amer. Soc. Test. Mat. Preprint*, 1933, 1-3).—Progress reports on specifications for hot-dip zinc coating of hardware and fastenings, for hot-galvanized coatings on structural steel shapes, for pipes and pipe fittings, and for methods of testing the coatings are recorded.—W. A. C. N.

**Proposed Tentative Specifications for Zinc Coating (Hot-Dip) on Hardware and Fastenings.** —(*Amer. Soc. Test. Mat. Preprint*, 1933, 4-7).—Appendix to Report of Sectional Committee on Zinc Coating of Iron and Steel (see preceding abstract). The specifications are not intended to apply to coatings on marine hardware or on articles formed after coating. The weights of coatings for various classes of material are given in tabular form. On all classes of hardware the covering must withstand four 1-minute dips when subjected to the Preece test. It must also adhere tenaciously to the base metal, be free from blisters, flux, black spots, dross, and sharp projections.—W. A. C. N.

**Report of Committee A-5 [of A.S.T.M.] on Corrosion of Iron and Steel.** J. H. Gibboney and James Aston (*Amer. Soc. Test. Mat. Preprint*, 1933, 1-4).—A revision of the standard methods of determining the weight of the coating on zinc-coated articles is recommended (see abstract below). Tentative specifications for galvanized iron or steel wires of various grades are now confirmed. Progress is reported on total immersion tests in sea-water of copper and non-copper bearing alloys. In field tests of metallic coatings it has been found that the relative resistance of zinc and iron to corrosion changes with location. Within a particular environment the durability of the zinc coating is substantially proportional to the weight of the coating. The results of inspections on various specimens are discussed. A report on embrittlement is also discussed (see abstract p. 504). Further information is being collected on the freedom of intermediate size shapes from injurious embrittlement, on the susceptibility to serious embrittlement of open-hearth

steel, and on the need for reducing the gauge length for testing intermediate shapes having small holes, and of measuring reduction in thickness in testing angles.—W. A. C. N.

**Report of Sub-Committee V [of Committee A-5 of A.S.T.M.] on Total Immersion Tests.** F. B. Olcott (*Amer. Soc. Test. Mat. Preprint*, 1933, 5-7).—Appendix to Report of Committee A-5 (preceding abstract). A detailed record of the failures of 173 copper bearing and 127 non-copper bearing No. 22-gauge sheets is given. Further progress on the observation of 16-gauge sheets is discussed. Examination of exposed riveted test-plates shows spongy corrosion and pitting about equally divided among the rivets. Calked rows appear to be in better condition than the others. Tests of rivets and plates in oil tankers are also being made.—W. A. C. N.

**Report of Sub-Committee VI [of Committee A-5 of A.S.T.M.] on Specifications for Metallic Coated Products.** F. F. Farnsworth (*Amer. Soc. Test. Mat. Preprint*, 1933, 8-10).—Appendix to Report of Committee A-5 (abstract above). Tentative standards for galvanized iron or steel wire for telegraphs and telephones, for ties, and for cable strands are confirmed. The use of a bend or mandrel test for determining the adherence of zinc coating on chain-link fence fabric which has been galvanized after weaving is not favoured. The tentative specifications for galvanized wire fencing and for barbed wire are to be revised completely.—W. A. C. N.

**Report of Sub-Committee VIII [of Committee A-5 of A.S.T.M.] on Field Tests of Metallic Coatings.** R. F. Passano (*Amer. Soc. Test. Mat. Preprint*, 1933, 11-23).—Appendix to Report of Committee A-5 (abstract above). Records of failures of exposed sheets are tabulated and curves given showing the progressive development of rust on the test-pieces. An orderly increasing development of rust in all the classes with increase in time of exposure is shown. Tests on uncoated sheets have also been made for comparison. The following 8 coatings on hardware, structural shapes, tubular goods, &c., have been investigated: (1) hot-dipped zinc; (2) electrodeposited zinc; (3) sherardized zinc in gas-heated drum; (4) sherardized zinc in electrically-heated drum; (5) electrodeposited cadmium; (6) hot-dipped aluminium; (7) hot-dipped lead (Amaloy); (8) Parkerizing. It is concluded that articles treated by processes 1-4 have approximately the same service life. There are no outstanding differences in the performance of any class of coating which are attributable to the nature of the base metal. The resistance to corrosion of a zinc coating depends substantially on the weight of coating and not on the method of application. Electrodeposited coatings are thinner on the recessed parts, and hence fail there first. The protection offered by cadmium is less than that of zinc applied with equal weight. Hot-dipped aluminium coatings give good protection, but are rough. In industrial areas where zinc and cadmium are rapidly weathered away lead is sufficiently resistant in itself, but tends to show pinholes. Parkerizing affords no suitable protection for outside service. In discussing other electrodeposited coatings the following statements are made: (1) protective value is determined principally by the total thickness of the nickel or of nickel and copper. Coatings less than 0.0005 in. thick give but little protection, but those with 0.002 in. are nearly perfect; (2) the presence of a copper layer reduces the protective value of a coating of given thickness; (3) very thin chromium coatings reduce the protective value of relatively thin deposits, whilst thicker coatings of this metal give added protection.—W. A. C. N.

**Report of Sub-Committee X [of Committee A-5 of A.S.T.M.] on Embrittlement Investigation.** V. F. Hammel and C. S. Trewin (*Amer. Soc. Test. Mat. Preprint*, 1933, 29-31).—Appendix to Report of Committee A-5 (abstract above). A progress report on the embrittlement of various classes of ferrous materials.—W. A. C. N.



**Proposed Revised Standard Methods of Determining Weight of Coating on Zinc-Coated (Galvanized) Iron and Steel Articles.** — (*Amer. Soc. Test. Mat. Preprint*, 1933, 32-38).—Appendix to Report of Committee A-5 (abstract p. 503). The methods are applied to sheets and wire. In the case of sheets, the shop weighing, spot test, hydrochloric acid-antimony chloride and sulphuric acid processes are described, whilst the basic lead acetate, sulphuric acid-permanganate, thermal, and hydrogen evolution methods are mentioned as good alternatives. In the case of wire, only the hydrochloric acid-antimony chloride method is given. In an appendix the determination of iron in zinc coatings is described in detail. It consists essentially in the titration of the iron by permanganate in the presence of mercuric chloride.—W. A. C. N.

**The Prevention of Corrosion.** Anon. (*Indian Engineering*, 1933, 93, 286).—An account of the Sherardizing process and its applications.—P. M. C. R.

**Metal Spraying as a Protection against Corrosion.** W. E. Ballard (*Metal-lurgia*, 1933, 8, 67-69).—The process of spraying a less corrodible metal such as zinc, aluminium, brass, or nickel on iron and steel is briefly explained, and the advantages gained from such a process in the treatment of large structures are considered. Among the applications of the process outlined are the treatment of bridges, tanks, filter-press plates, and steel windows with zinc; of gas-holder shells with aluminium to resist the action of sulphur; and the treatment of light alloys of aluminium, such as Duralumin, with pure aluminium so as to increase their resistance to corrosion. The process known as aluminizing, where aluminium is sprayed on steel and subsequently heat-treated, is also dealt with, and various practical applications of the process in the treatment of heat-treatment boxes and pots, superheaters, and chain-links are referred to.—J. W. D.

**Metal Spraying Technique.** Anon. (*Chem.-Zeit.*, 1933, 57, 381-382).—To obtain a homogeneous lead coating on iron and steel that will resist hot and cold sulphuric acid of *d* 1.8, a new type of pistol has been developed. In this pistol a 3-mm. lead wire is fed through the orifice at 3.5 m./second by means of a turbine driven by carbon dioxide taken at 2 atm. pressure from a steel cylinder. The exhaust gas from the turbine is passed through a chamber in which it is heated by means of an oxy-hydrogen flame to 300°-900° C., and is then passed through the orifice with the lead wire, which is thereby melted and atomized in a non-oxidizing atmosphere. The heating chamber is made of steel which has been sprayed with aluminium and heated to cause the coating to diffuse into the metal and give a non-scaling surface. The pistol weighs only 1.2 kg., and uses 600 litre/hr. of carbon dioxide at 92% efficiency.—A. R. P.

**New Electrical Method for the Spraying of Metals.** Anon. (*Technique moderne*, 1933, 25, 242-243).—Abstracted from *Electrotech. Z.*, 1932, 53, 1178. See *J.*, this volume, p. 248.—R. B. D.

**Comparative Tests of Nitrocellulose Lacquer Coats on Duralumin and Wood.** — Tichonov (*Malyarnoe Delo*, 1932, (1), 36; and (in German) *Nitrocellulose*, 1932, 3, 227; *C. Abs.*, 1933, 27, 1526).—[In Russian.] Nitrocellulose lacquers were tested thoroughly on Duralumin and wood parts of aeroplanes and found satisfactory.—S. G.

**Modern Lacquer Finishing.** Ray C. Martin (*Metal Cleaning and Finishing*, 1932, 4, 555-558, 603-606, 610, 647-650; *C. Abs.*, 1933, 27, 1772).—The characteristics of the various types of nitrocellulose, cellulose acetate, and ethylcellulose employed in lacquers are briefly described. The use of alkaline solvents in nitrocellulose lacquers, the distinction between solvents and diluents, and the desirable properties of nitrocellulose solvents are discussed.—S. G.

**Cellulose Esters and Lacquers.** Anon. (*Indust. Australian*, 1933, 88, 144).—The formation of degradation products of cellulose and its acetates is stated

to be due to the critical temperature having been exceeded in process of manufacture. This temperature varies according to conditions, especially with the sulphuric acid concentration. By careful control of temperature it is now possible to maintain simultaneously a low viscosity, a high proportion of cellulose derivative, and a good compatibility with gums and resins, thus improving the quality of cellulose-ester lacquers and varnishes.—P. M. C. R.

**Chemical Injection in Kansas Wells Retards Corrosive Action.** Anon. (*Oil Weekly*, 1933, 70, (3)).—Corrosion of plant in certain Kansas oilfields has been traced to a combination of hydrogen sulphide content in the oil and low brine concentration in the associated water. The use of anti-corrosive alloys and the application of electrolytic protection failed to eliminate the trouble, which is now overcome by the injection of caustic soda containing certain variable colloidal ingredients. Methods of application are described.—P. M. C. R.

## VI.—ELECTRODEPOSITION

(Continued from pp. 445-449.)

**Tests of Thickness of Protective Cadmium Coatings on Steel.** S. G. Clarke (*J. Electrodepositors' Tech. Soc.*, 1933, 8, (11), 1-10; and (abstract) *Met. Ind. (Lond.)*, 1933, 43, 153-157).—Three methods, applicable in different cases, are described. (1) Iodine drop method, for larger articles. Drops of a 10% solution of iodine in 20% potassium iodide solution are allowed to fall from a small jet at 1 drop per second on the article supported at about 45° and about  $\frac{3}{4}$  in. below the jet; perforation is marked by the appearance of a spot of the basis steel within the area tested, and the number of drops required, divided by 18, gives the thickness of coating in ten-thousandths of an inch ( $\pm 15\%$ ). A suitable apparatus is described. (2) Acid stripping method, for smaller parts. The article is immersed in a solution of 20 gm. of antimony trioxide per litre of hydrochloric acid (sp. gr. 1.146) at 60°-75° F. (16°-24° C.) until gassing has subsided. The loss in weight after stripping may be determined and the thickness calculated when the surface area is known, giving accurate results. The number of seconds during which gassing occurs, divided by 30, gives an approximation ( $\pm 50\%$ ) to the thickness in ten-thousandths of an inch, which may be of value in cases where the surface area cannot be readily measured, e.g. for small screws. (3) A 5% solution of ammonium persulphate to which is added 10% by volume of concentrated ammonia (sp. gr. 0.88), which is without action on steel but readily dissolves cadmium, may be used for stripping the deposit for determination from loss in weight. Articles must be freed from grease before testing.—S. W.

**The Detection and Significance of Porosity in Electrodeposited Cadmium Coatings on Steel.** S. G. Clarke (*J. Electrodepositors' Tech. Soc.*, 1933, 8, (12), 1-20; and (summary) *Met. Ind., (Lond.)*, 1933, 43, 15-16, 61-62, 109-110).—Porosity may be detected by immersing the article, from which all greasy matter has been removed, in dilute hydrochloric acid (1% of concentrated acid in distilled water) for up to 10 minutes, when hydrogen bubbles form at discontinuities. With large pores or numerous small pores the bubbles form within a few minutes, but the full period is necessary for detecting slight porosity. The test is non-destructive of the coating. Coatings deposited from cyanide plating solutions of the usual composition on rolled steel of good quality are ordinarily substantially non-porous, even when of extreme thinness (e.g. 0.00005 in.), but may be distinctly porous on cast steel when of greater thickness. In the early stages of use of the solutions, however, deposits produced on rolled steel may be appreciably porous, but less so as the thickness is increased to 0.0005 in. The effects of porosity and

discontinuities in cadmium coatings on steel under condition of exposure outdoors and in a Stevenson screen have been studied: (1) by determining the influence of contact with steel on the rate of corrosion of cadmium; (2) by carrying out tests of cadmium coatings of varying porosity and thickness. Porous coatings are attacked more rapidly than continuous coatings, and the factors deciding the degree of acceleration appear to be the total area of steel exposed at the pores and the severity of the corrosive conditions. With highly porous and very thin coatings (0.0001 in.), the stimulation of attack was marked, but with the lower porosity found with coatings of good commercial thickness (say, 0.0003 in. and above), the effect was relatively slight. On atmospheric exposure, the sacrificial protection afforded to exposed steel is slight, but sufficient to protect from rusting tiny areas of exposed steel, such as at pores; at small areas which are just visible to the naked eye, partial protection is afforded, but at larger areas rusting tends to proceed. It is concluded that slight porosity in a cadmium deposit is unlikely to affect its protective properties under ordinary conditions of use to an appreciable extent, but where pores are very numerous, a lower degree of protection than that afforded by a sound deposit of similar thickness may be anticipated.—S. W.

**The Influence of Anions on the Electrodeposition and Solution of Cadmium and Zinc.** Erich Müller and Herbert Barchmann (*Z. Elektrochem.*, 1933, 39, 341-352).—The overvoltages which occur in the cathodic deposition and anodic solution of cadmium and zinc in solutions of their single salts have been determined. The current density-polarization curves showed decreasing steepness in the order chloride, bromide, sulphate, perchlorate. Raising the temperature leads to a straightening-up (*Aufrichtung*) of the curves. The explanation of the experimental results put forward is that there is a relation between the polarization and the extent of the anion radius. The current efficiency for the cadmium deposition had a mean value of 94-99%, being higher with higher temperatures. Increasing concentration of the anions had a depolarizing effect. Thick deposits of cadmium were obtained from perchlorate solutions, especially the sodium salt. Gelatine raised the over-voltage and effected a grain-refinement of the cadmium deposit. In the presence of gelatine, thick deposits of cadmium were obtained from sulphuric acid solutions of cadmium sulphate.—J. H. W.

**Organic Addition Agents for Cadmium Electroplating.** R. A. Claussen and H. L. Olin (*Metal Cleaning and Finishing*, 1933, 5, 211-214).—See *J.*, this volume, p. 249.—S. G.

**Throwing Power of Chromic Acid Baths.** K. Altmannberger (*Chem.-Zeit.*, 1933, 57, 293-294).—The throwing power of chromic acid baths containing sulphuric acid is better with dilute than with more concentrated solutions at the same current density; the range of bright deposits is narrowed by increasing the chromic acid concentration, but at 35°-40° C. the concentration range for bright deposits is considerably enlarged. With a bath containing 250 gm./litre of chromic acid a  $\text{CrO}_3$ : $\text{SO}_4$  ratio of 200:1 gives a better throwing power than a ratio of 100:1. A higher chromic acid concentration improves the throwing power, but reduces the lustrous range. A. recommends a bath with 350 gm./litre of chromic acid and profiled anodes to homogenize the current lines.—A. R. P.

**The Control of Electrodepositing Solutions. XVI.—The Chromium Solution.** Samuel Field (*Met. Ind. (Lond.)*, 1933, 43, 13-14).—Describes the methods for determining the sulphuric acid by reducing the chromic acid to chromium chloride with hydrochloric acid and alcohol and precipitating with barium chloride, and of estimating the iron and trivalent chromium by weighing as oxides.—J. H. W.

**The Electrodeposition of Chromium from Tervalent Chromium Salt Solutions. II.—Chromium Acetate, Oxalate, and Tartrate Baths.** Hubert Thomas

Stanley Britton and Oliver Brentwood Westcott (*J. Electrodepositors' Tech. Soc.*, 1933, 8, (5), 1-9. Reprinted from *Trans. Faraday Soc.*, 1932, 28, 627-634).—See this *J.*, 1932, 50, 758.—S. W.

**Determination of the Thickness of Chromium Deposits.** O. Macchia (*Industria chimica*, 1932, 7, 717-725).—The life of a chromium deposit depends on its thickness and the quality (porosity, hardness, &c.). The various methods of determining the thickness (electrochemical and gravimetric) are critically reviewed and the best results are said to be obtained by covering all but a measured portion of the plated surface with paraffin wax or grease, subjecting this exposed portion to the action of hydrochloric acid, and determining the amount of chromium in the resulting solution. The small area from which the chromium has been dissolved may readily be replated.—G. G.

**Cathode Supports for Chromium Plating.** R. J. Piersol (*Metal Cleaning and Finishing*, 1933, 5, 67-70, 84; *C. Abs.*, 1933, 27, 2099).—The requirements of cathode supports for large articles are discussed.—S. G.

**Chromic Acid Poisoning.** R. W. Graham (*Canad. Med. Assoc. J.*, 1932, 27, 645-646; *C. Abs.*, 1933, 27, 909).—A patient engaged in chromium plating for 2½ years developed an excessively troublesome cough and hoarseness. There were also loss of sleep and weight with anorexia and fatigue and nose bleeding. The nasal septum was perforated. Removal from the fumes, inhalations of Friar's balsam, free elimination from the bowels and bladder, together with an iron tonic, resulted in complete recovery.—S. G.

**Chromium Plating for Abrasion and Corrosion-Resistance.** George S. Brady (*Metal Cleaning and Finishing*, 1933, 5, 164-166; *C. Abs.*, 1933, 27, 3143).—A general discussion of the application of chromium plating to machine parts to increase their service qualities.—S. G.

**Chromium Plating Finds New Applications in the Machine Shop.** N. H. McKay and C. F. Bonnet (*Machinery (N. Y.)*, 1933, 39, 576-579; and (abstract) *Results Obtained with Chromium Plated Cutting Tools (Machinery (Lond.)*, 1933, 42, 218).—The characteristics of chromium deposits applied directly to the base metal are outlined, and their use as hard facings for guide strips, machine parts, and cutting tools, and as a means of reclaiming under-sized parts, is discussed.—J. C. C.

**The Electrodeposition of Iron-Cobalt Alloys.—I, II.** S. Glasstone and J. C. Speakman (*J. Electrodepositors' Tech. Soc.*, 1933, 8, (5), 10-23. Reprinted from *Trans. Faraday Soc.*, 1933, 29, 426-429).—See *J.*, this volume, p. 360.—S. W.

**Carbonate in Cyanide Copper Plating.** L. C. Pan (*Metal Cleaning and Finishing*, 1933, 5, 19-22, 81-84; *C. Abs.*, 1933, 27, 2099).—The resistivity of a cyanide copper solution decreases rapidly with increasing amounts of sodium carbonate up to 100 gm./litre. The anode polarization is reduced rapidly by the addition of sodium carbonate, the minimum being reached at about 42 gm./litre. The cathode polarization is practically unaffected by the presence of sodium carbonate except for a slight minimum at about 42 gm./litre. The bath voltage follows approximately the characteristics of the anode polarization. Throwing power shows a sharp maximum at 42 gm. sodium carbonate per litre and another, higher, maximum at 221.5 gm./litre. The anode efficiency is greatly reduced in the presence of sodium carbonate, with the exception of a small rise to a maximum at 12.5 gm./litre. The anode and cathode efficiencies intersect at two points, *viz.*, 5 and 30 gm. sodium carbonate per litre. The cathode efficiency decreases slightly with increasing sodium carbonate content. The anode film formed in the presence of sodium carbonate is soluble immediately in the solution, whereas the anode film formed in the absence of sodium carbonate is insoluble while the plating takes place. The cathode deposit shows a maximum brightness

at 20 gm. sodium carbonate per litre. All factors being considered, the optimum sodium carbonate content would be about 42 gm./litre.—S. G.

**Concentration of Cyanide Copper Plating Solutions.** L. C. Pan (*Metal Cleaning and Finishing*, 1933, 5, 112-114, 152-154, 166-167; *C. Abs.*, 1933, 27, 3144).—The effects of concentration on anode and cathode efficiencies, on polarization, on resistance, on throwing power, and on appearance of the deposit are discussed. A cyanide copper-plating bath containing 1 mol. copper, 0.29 mol. free cyanide, and 0.39 mol. sodium carbonate per litre is most desirable and would be materially better than many of those now being used.—S. G.

**Nickel-Plating of Aluminium.** J. A. Sprenger (*Tecnica del Lavoro*, 1932, (9), 23-24).—A short note.—G. G.

**The Nickel Plating of Zinc-Base Die-Castings at High Current Density.** N. R. Laban (*J. Electrodepositors' Tech. Soc.*, 1933, 8, (6), 1-8).—A coating of nickel or copper and nickel of high adhesion and at least 0.0005 in. thick is essential prior to chromium plating. The following method has been satisfactorily worked by relatively unskilled labour; owing to the high current density and simple method used, the plant required is inexpensive. The articles are degreased by the trichloroethylene vapour method shortly before plating: they are anodically etched for  $\frac{1}{2}$  to 1 minute in 75-80% sulphuric acid at 10 v., very thoroughly swilled, and copper plated in CuCN 3.5, NaCN 5.0, Na<sub>2</sub>CO<sub>3</sub> 2.0, Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub> 0.17 oz. per gall. at 50 amp./ft.<sup>2</sup> and 65° C. for a few minutes. The articles are rinsed and immersed in potassium hydrogen tartrate solution; they are then nickel plated in NiSO<sub>4</sub>·7H<sub>2</sub>O 2.5-3 lb., NaCl 2 oz., H<sub>3</sub>BO<sub>3</sub> 3 oz. per gall. at 80 amp./ft.<sup>2</sup> and 60° C.,  $p_H$  5.2-5.8, for 11 minutes; the solution is vigorously agitated by compressed air. Owing to the high currents used, the articles are suspended on special jigs of ample cross-section. Finishing costs are not materially increased by the etching process, and rejects are stated to be markedly reduced.—S. W.

**Electrodeposition of Nickel.** M. Ballay (*Congrès internat. d'Elect., Paris, Section 7, Rapport No. 7*, 1932, 1-10; *Sci. Abs.*, 1932, [B], 35, 704).—B. states that the two important applications of electrodeposition of nickel are: (1) as a protective coating against corrosion, and (2) the production of refined nickel from crude or impure metal. He discusses the latest advances in both branches of the industry as follows: (1) slow and quick methods of nickel plating; (2) plating on aluminium; (3) plating on zinc and its alloys; (4) management of the plating baths; (5) organization of the work; (6) repair work by thick deposits of the metal; (7) production of nickel anodes; and (8) refining crude nickel.—S. G.

**Electrolytic Preparation of Heavy Seamless Nickel Tubes.** Naoto Kameyama and Sojiro Oka (*J. Electrochem. Soc. (Japan)*, 1932, 157-160; *C. Abs.*, 1933, 27, 2626).—[In Japanese.] Several precautions are given for the electrolytic preparation of seamless nickel tubes 1 mm. thick, 2 cm. in diam., and 20 cm. long. The best results were obtained with Langbein's bath at 70° C., and a current density of 1 amp./dm.<sup>2</sup>. The hydrogen content of the deposited nickel was 0.003% by weight.—S. G.

**The Electrodeposition of Palladium.** R. H. Atkinson and A. R. Raper (*J. Electrodepositors' Tech. Soc.*, 1933, 8, (10), 1-20; and (abstract) *Met. Ind. (Lond.)*, 1933, 42, 595-598).—Palladium is a white metal similar in corrosion-resistance to platinum. A sulphide coating is not formed in the atmosphere, and thus palladium is suitable for coating silver articles, jewellery, reflectors, &c. Coatings of at least 0.0002 in. are advised to avoid porosity, since protection is mechanical and not electrochemical. The history of palladium plating is fully reviewed. The simple salts are easily hydrolyzed and unsuitable as electrolytes. A complex nitrite or ammine palladium salt is used. Two processes are described in detail,

including preparation and analysis of the electrolyte: (i) Electrolyte  $\text{Na}_2(\text{Pd}(\text{NO}_2)_4)$  10,  $\text{NaCl}$  30 grm./litre, palladium anodes, current density 0.1 amp./dm.<sup>2</sup>, 40°–50° app. 1.5 v.,  $p_{\text{H}}$  value need not be controlled, but rises from 4.9 to 8.0 in use. Deposits up to 0.0001 in. thick are satisfactory and lustrous; polishing is unnecessary. Thicker deposits tend to be cracked. Diamond hardness number 387–435. (ii) A two-compartment cell with porous diaphragm, e.g. as in a Leclanché cell or porous hard rubber, is used with insoluble anodes of lead. The catholyte contains 40 grm.  $\text{Pd}(\text{NH}_3)_2\text{Cl}_2$  dissolved in 35 c.c.  $\text{NH}_3$  solution (0.880) and 10 grm.  $\text{NH}_4\text{Cl}$  per litre, the anolyte  $(\text{NH}_4)_2\text{CO}_3$  10 grm.,  $(\text{NH}_4)_2\text{SO}_4$  20 grm.,  $\text{NH}_3$  solution (0.880) 50 c.c./litre. The catholyte is regenerated with  $\text{Pd}(\text{NH}_3)_2\text{Cl}_2$ ,  $\text{NH}_4\text{Cl}$  accumulates in the anolyte. Current density 0.5 amp./dm.<sup>2</sup> at 3° C. to 2.0 at 70° C.,  $p_{\text{H}}$  9–10 (catholyte). Deposits up to 0.01 in. are coherent and easily polished, but brittle. Diamond hardness number 193–196. Current efficiency is high. Cathode polarization curves for both processes are given. Deposition is most satisfactory on silver, copper, or copper-base alloys and nickel. Deposits may be stripped anodically from silver in  $\text{NaCl}$  100,  $\text{HCl}$  3.6 grm./litre.—S. W.

**Practical Problems Involved in Commercial Electroplating on Aluminium.** Harold K. Work (*J. Electrodepositors' Tech. Soc.*, 1933, 8, (7), 1–11; and *Met. Ind. (Lond.)*, 1933, 42, 499–502, discussion, 502–550).—Adhesion of nickel plate to aluminium and its alloys is obtained by degreasing in  $\text{Na}_3\text{PO}_4$  1–3,  $\text{Na}_2\text{CO}_3$  1–3, oz. per gall. at 80°–90° C., etching for 10–15 seconds in 5% hydrofluoric acid. A further etching process, varied for different alloys and cast or wrought material, is applied to roughen the surface and produce pits of under-cut shape which key the electrodeposit to the basis metal. Suitable acid etches are given. The time of etching and the temperature and acidity of the etching solution need to be carefully controlled. The etched article is nickel plated in a solution containing  $\text{MgSO}_4$  or  $\text{Na}_2\text{SO}_4$  with increased polarization (sample composition given) with at least 0.0005 in., preferably 0.001 in., of deposit. Polishing of the deposit is difficult, and adhesion, although adequate, is not high. Other metals such as chromium or copper can be deposited on the nickel plate. A procedure for zinc-plating aluminium, of value for electrical contact purposes, is described.—S. W.

**The Plating of Zinc and Zinc-Base Die-Castings.** L. Wright and F. Taylor (*J. Electrodepositors' Tech. Soc.*, 1933, 8, (8), 1–19; and (abstract) *Met. Ind. (Lond.)*, 1933, 42, 355–358, 405–406).—The difficulties of direct nickel plating are discussed and the literature is reviewed. Degreasing is difficult in aqueous solutions owing to attack on the metal and tarnishing: cathodic cleaning at low current density for not more than 3 minutes in a solution of sodium silicate 10,  $\text{Na}_3\text{PO}_4$  30 grm./litre operated at boiling point is advised. Etching is essential, 1–2% hydrofluoric acid or preferably 8% hydrochloric acid for 0.5–1 minute is satisfactory. Preliminary plating with brass or copper is unsatisfactory owing to the formation of blisters. Direct nickel plating can be achieved using a solution  $\text{NiSO}_4 \cdot 7\text{H}_2\text{O}$  75,  $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$  200,  $\text{NH}_4\text{Cl}$  12,  $\text{H}_3\text{BO}_3$  10 grm./litre at room temperature,  $p_{\text{H}}$  6.0  $\pm$  0.2, 10 amp./ft.<sup>2</sup>. A thickness of not less than 0.00035 in. is advised. The effect of varying the constituents and operating conditions of the solution is shown.—S. W.

**On Rust-Protective Metal Coatings.** W. Borchert (*Oberflächentechnik*, 1933, 10, 85–86).—Excellent protection of iron from rusting is afforded by a cadmium coating 0.005–0.01 mm. thick with outer coatings of nickel and chromium, provided that these are non-porous. Penetration of corrosive media is rapid through pores in the outer layers, and corrosion quickly spreads by electrolytic action.—A. R. P.

**Contribution to Our Knowledge of the Throwing Power of Electrolytic Baths.** Victor Engelhardt and Nikolaus Schünfeldt (*Wiss. Veröff. Siemens-Konzern*, 1933, 12, (1), 34–38).—In acid and alkaline copper-plating baths, in

sulphate nickel-plating baths and in chromic acid baths, the throwing power depends on the dimensions of the electrodes and on the dimensions of the cell.—A. R. P.

**Electrodeposition of Metals and Alloys from Formamide Solutions.** R. D. Blue and F. C. Mathers (*Electrochem. Soc. Preprint*, 1933, May, 327-334).—Addition of dry hydrogen chloride to solutions in formamide of the chlorides of copper, zinc, bismuth, nickel, iron, and chromium improves the character and adherence of the deposits obtained by electrolysis, but is without action on the nature of the deposits obtained from solutions of tin, lead, and cadmium chlorides. Zinc and nickel thiocyanates give good deposits in formamide solution, but the corresponding cadmium salt gives only fair deposits. Stannous thiocyanate gives a poor deposit, and cuprous thiocyanate is insoluble. Aluminium chloride alone gives no deposit of aluminium, but on addition of ferric chloride a bright white alloy deposit is obtained which may contain up to 17% of aluminium; this alloy rapidly decomposes water. Alloys of zinc and manganese with a very small proportion of aluminium can be obtained from formamide solutions of the chlorides, but they are very reactive. No alloys of aluminium with any other metal could be obtained.—A. R. P.

**Discussion on the Possibility of Standardizing Electrodeposits.** R. S. Hutton. E. A. Ollard. S. E. Weill. E. J. Dobbs. T. L. Crow. A. Tremayne. L. Wright. J. W. Perring. A. W. Hothersall. C. Hobday. S. Wernick (*J. Electrodepositors' Tech. Soc.*, 1933, 8, (1), 1-6; and *Met. Ind. (Lond.)*, 1932, 41, 427-429).—The possibility and desirability of drawing up standard specifications for electrodeposits of various kinds are discussed. Representatives of the cutlery trade consider standardization of silver plate feasible and advisable, but it is considered that it would be difficult to obtain general trade acceptance of specifications for other electrodeposits.—S. W.

**Standards in the Plating Industries.** Anon. (*Met. Ind. (Lond.)*, 1932, 41, 339-340).—Editorial comment on a discussion opened by E. A. Ollard before the Electroplaters' and Depositors' Technical Society (preceding abstract). It is agreed that it is possible and even desirable to institute particular standards of electroplating on particular articles, but it is considered impossible and not necessarily desirable to issue a general standard of plate applicable to all kinds of plated articles and in any case even restricted standardization presents great difficulties.—J. H. W.

**Research and Electrodeposition Practice—Presidential Address.** D. J. Macnaughtan (*J. Electrodepositors' Tech. Soc.*, 1933, 8, (2), 1-8; and *Met. Ind. (Lond.)*, 1932, 41, 593-595, 598).—The development of the motor-car industry and the competition of stainless alloys and cellulose lacquers have stimulated the electroplating industry to intensive research. Certain processes, such as chromium plating, are the result of academic research, and were not immediately adopted by the trade. Modern research is, however, directed to obtaining quantitative data on the physical properties, adhesion, corrosion-resistance, &c., of electrodeposits.—S. W.

**Advances in Electroplating.** Herbert Kurrein (*Oberflächentechnik*, 1933, 10, 141-143).—A review of recent patents and journal literature with 103 references.—A. R. P.

**Recent Developments in Electroplating.** M. de Kay Thompson (*Metal Cleaning and Finishing*, 1933, 5, 9-18; *C. Abs.*, 1933, 27, 1829).—A review of recent, more important technical developments in the electroplating of chromium, nickel, cadmium, alloys, silver, zinc, tungsten, tin, and platinum, together with notes on temperature corrections in measuring throwing power and electroplating on aluminium.—S. G.

**Electroplating in Great Britain.** D. J. Macnaughtan (*Congrès internat. d'Élect., Paris, Sect. 7, Rapport No. 6*, 1932, 1-35; *Sci. Abs.*, 1932, [B],

35, 703).—A report on recent research work relating to the electrodeposition of metals carried out in Great Britain under the auspices of the Electroplaters' and Depositors' Technical Society and of the British Non-Ferrous Metals Research Association. The researches covered are: A. W. Hothersall, "The Electrodeposition of Nickel, Chromium, Copper, Silver, Zinc, Cadmium, Iron, Manganese and Alloys"; E. J. Dobbs, "Rapid Nickel Plating"; E. A. Ollard, "Chromium Plating"; S. Wernick, "Zinc and Cadmium Plating"; and H. Sutton, "The Anodic Oxidation of Aluminium and its Alloys." Each paper is accompanied by a bibliography of recent contributions to the technical literature of the subject.—S. G.

**Idealism in Electrodeposition.** S. Field (*J. Electrodepositors' Tech. Soc.*, 1933, 8, (9), 1-7).—First William James Memorial Lecture.—S. W.

## VII.—ELECTROMETALLURGY AND ELECTROCHEMISTRY

(Other than Electrodeposition and Electro-Refining.)

(Continued from pp. 449-459.)

**Electrolytic Extraction of Metals.** H. J. Ellingham (*Sci. J. Roy. Coll. Sci. (Lond.)*, 1932, 2, 19-26).—A review.—S. G.

**The Technique of Aluminium Manufacture.** Jaime Forsch (*Quim. e Ind.*, 1932, 9, 258-264).—A review.—S. G.

**Rate of Dissolution of Industrial Alumina in Molten Cryolite.** N. Parravano and — D'Agostino (*Rend. Accad. Naz. Lincei*, 1932, 16, 186-190).—From electrical conductivity measurements in fused cryolite it is concluded that the rate of dissolution of the various technical grades of alumina in cryolite baths is different, the rate is highest with alumina made by the Blanc process and lowest with that made by the Haglund process. This factor greatly influences the cost of production of aluminium.—G. G.

**Metallic Beryllium at Low Cost.** Anon. (*Indust. Australian*, 1933, 88, 125).—A summary of the properties and sources of beryllium, with notes on methods of extraction.—P. M. C. R.

**Electrochemical Industry of Japan.** N. Kameyama (*Congrès internat. d'Élect., Paris, Sect. 7. Rapport*, No. 21, 1932, 1-17; *Sci. Abs.*, 1932, [B], 35, 703).—K. gives details of the present development of the electrochemical industries of Japan, with an estimate of the energy consumed in 1930 and of the tonnage produced of various products. In that year, for the electrolytic production of chemicals and metals by wet processes the energy consumption was 1446 million kw.h., whilst electric thermal manufacturers accounted for another 2404 kw.h. The latter total does not include the energy used in the manufacture of steel, ferro-alloys or other similar products. The tonnages of metals produced in 1930 by electrolytic methods were: refined copper, 78,000 tons; lead, 3600 tons; tin, 800 tons; zinc, 4000 tons; sodium, 1000 tons. K. points to the considerable surplus power available in Japan for other electrochemical industries.—S. G.

**Passivity Phenomena in Metals.** Max Schlötter (*Chem.-Zeit.*, 1933, 57, 533).—Under certain conditions of deposition very passive deposits of nickel, chromium, copper, and silver can be obtained which behave quite differently from ordinary deposits. The passive chromium and nickel contain highly dispersed oxide inclusions, and the silver and copper (obtained from iodide solution) contain iodides of these metals. Passive chromium is not wetted by water, and is therefore highly resistant to corrosion; passive nickel is attacked by sulphides only with great difficulty, and the gold-coloured silver containing 0.99% iodine obtained from solutions of silver iodide in potassium iodide is not attacked by liver of sulphur. S. suggests that these substances should be called "metallides," thus the silver mentioned above would be called "0.99 silver iodine metallide." Copper iodine metallide is photo-



sensitive, becoming blue on exposure to light and reverting to red in the dark.—A. R. P.

**Hydrogen Overvoltage of Lead and Lead-Antimony Alloys.—I, II.** Yogoro Kato (*J. Electrochem. Soc. (Japan)*, 1932, 120-124, 161-167; *C. Abs.*, 1933, 27, 2628).—[In Japanese.] Cf. *J.*, this volume, p. 362. (I.—) The hydrogen overvoltage of lead-antimony alloy (1-10% antimony) cathodes varies from the very beginning of the passage of electric current. Neither rapid nor slow cooling of the alloy appreciably affects the overvoltage. It is, however, very low for antimonized lead. An alloy having an especially high overvoltage, such as that reported by Raeder (*Z. physikal. Chem.*, 1928, 133, 15-30) could not be found. (II.—) In the determination of overvoltage at the same current density, it was found that it varies at first with the time, and then approaches a definite value. The hydrogen overvoltage on lead depends on the surface condition of the cathode; it is high on a smooth surface and low on a rough surface. On the single crystal surface of lead, it is high, even when the surface is etched. The hydrogen overvoltage for cast lead, lead-antimony alloy and antimony, determined at a current density of 0.3 ma./dm.<sup>2</sup> was highest for lead (1.00 v.), next for lead-antimony alloy (5% antimony) (0.67 v.), and lowest for antimony (0.51 v.).—S. G.

**A Study of the Tellurium Electrode.** Frederick H. Getman (*Electrochem. Soc. Preprint*, 1933, Sept., 1-8).—Single crystals of tellurium have been prepared by slowly passing a sealed tube containing coarsely crushed metal through a furnace. Using these crystals the e.m.f. (*E*) of the cell Te-*m*TeCl<sub>4</sub> in 2.5*N*-HCl-saturated KCl-Hg<sub>2</sub>Cl<sub>2</sub>-Hg has been determined. *E* is a linear function of log *m* within the range, *m* = 0.0004-0.1 molar. From the results obtained it follows that for Te-Te<sup>+++</sup>E<sub>0</sub> = - 0.5682 v.—A. R. P.

### VIII.—REFINING (Including Electro-Refining.)

(Continued from pp. 450-451.)

**Electrolytic Refining of Metals.** G. Eger (*Congrès internat. d'Élect., Paris, Sect. 7, Rapport No. 9*, 1932, 1-18; *Sci. Abs.*, 1932, [B], 35, 705).—Describes the methods now adopted for the electrolytic refining of copper, silver, gold, lead, zinc, cadmium, tin, iron, nickel, antimony, and bismuth. Illustrations of the methods and plant used for copper refining are included.—S. G.

**Modern Electrolytic Refining.** Anon. (*Met. Ind. (Lond.)*, 1933, 43, 51-52).—A short general dissertation on modern electrolytic refining and some of the difficulties encountered therein, especially with respect to lead, magnesium, and aluminium.—J. H. W.

**Current Efficiency in the Electrolytic Production of Copper.** A. I. Gaev (*Zvetnye Metally (The Non-Ferrous Metals)*, 1930, 562-573; *C. Abs.*, 1933, 27, 667).—[In Russian.] The current consumption in the electrolytic production of copper at the Nijhne-Kuishtuimsk plant is given. Efficiency was between 64.4 and 73.8%. Improvements, to increase current efficiency, are recommended.—S. G.

**The Metallurgy of Gold in the Transvaal.** B. Kucevalov (*Chem. Listy*, 1932, 26, 600-604; *C. Abs.*, 1933, 27, 1847).—A survey of the geology, mining methods, cyanide and refining processes used for the preparation of metallic gold.—S. G.

**Electrodeposition of Zinc.** P. Röntgen and R. Buechkremer (*Metallurgist (Suppt. to Engineer)*, 1933, 9, 38-43).—A detailed summary, with illustrations, of a paper by R. and B. *Metall und Erz*, 1932, 29, 449. See *J.*, this volume, p. 450.—R. G.

## IX.—ANALYSIS

(Continued from pp. 451-454.)

**Use of the Photographic Plate in Quantitative Analysis with Emission Spectra.** C. F. Linström and G. Scheibe (*Ber. VIII. Internat. Congr. Photography, Dresden, 1931*, 355-356; *C. Abs.*, 1933, 27, 672).—The photometric methods which are employed in quantitative analysis with emission spectra are discussed, as also are the possible sources of error in this kind of work which may arise from the use of the photographic plate. The effect of the kind of plate, and of development (manner, time, and temperature), and of the gradation in the various regions of the spectrum is discussed in regard to the Scheibe-Neuhäusser method of logarithmic sector and the 3-line methods of Scheibe-Schnettler.—S. G.

**Spectrographic Analysis of Lead Cable-Sheath Alloys.** G. H. Metson (*Post Office Elect. Eng. J.*, 1932, 25, 143-147; *Sci. Abs.*, 1932, [B], 35, 699).—The optical spectrum of a Pb-Sb alloy consists of numerous spectral lines due to the Pb and a smaller number due to the Sb. The intensity of the latter increases in a regular manner as the Sb percentage increases. In the rotating logarithmic sector photometer a disc is used, the outer edge of which is cut in a logarithmic spiral, is placed in front of the spectrograph slit and is rotated by a small electric motor. Each spectral line is thus exposed logarithmically along its length, the photograph being a narrow wedge instead of a parallel-sided bar. Since the law of photographic blackening is also logarithmic, the length of a particular Sb line-wedge is a measure of the line intensity and also of the Sb concentration of the alloy.—S. G.

**Surface Effects on Assay Bands Caused by Metals of the Platinum Group.** J. L. Byers (*Bull. Michigan Coll. Min. Tech.*, 1933, 6, 1-17).—See this *J.*, 1932, 50, 441.—S. G.

**Detection of Silver in Very Dilute Solutions by Physical Development.** A. J. Velculescu (*Z. anal. Chem.*, 1932, 90, 111-113).—One drop of the solution to be tested is placed on a filter paper and treated with a 0.02*N*-solution of KBr. After thorough washing to remove soluble salts, the spot is treated with 50 c.c. of developer solution (*D*) to which 2 c.c. of 0.1*N*-AgNO<sub>3</sub> are added just before use. If the spot contains AgBr, much of the Ag in the solution is reduced, and the spot becomes black. The method detects 1 part of Ag in 10<sup>7</sup> parts of solution even in the presence of 2000 times as much Pb, provided that no free HNO<sub>3</sub> is present. Hg interferes, and should be removed by evaporation of the solution and ignition of the residue prior to making the test. Solution *D* contains 10 gm. of metal and 50 c.c. of citric acid in 500 c.c. of H<sub>2</sub>O.—A. R. P.

**Application of Catalysis to the Detection of Certain Cations.** Detection of Silver and Copper. Applications of the Method. Georges Denigès (*Bull. Soc. Chim. France*, 1932, [iv], 51, 1096-1100).—The oxidation of MnSO<sub>4</sub> to HMnO<sub>4</sub> by K<sub>2</sub>S<sub>2</sub>O<sub>8</sub> in the presence of Ag and by NaOBr in the presence of Cu may be used for the detection of these elements. Hg and Co interfere in the Ag test, and Ni and Co in the Cu test. The method may be used for the detection of Ag in coins: a small drop of HNO<sub>3</sub> is placed on the coin, and after 10 seconds the solution is rinsed into a test tube and heated to 100° C. with 20 drops of H<sub>2</sub>SO<sub>4</sub>, 2 drops of 0.4% MnSO<sub>4</sub> solution, and 0.1 gm. of K<sub>2</sub>S<sub>2</sub>O<sub>8</sub>, when a pink colour develops if the coin contains Ag. Other applications of the method are detailed.—A. R. P.

**On the Separation of Titanium from Aluminium and Certain Elements of Analytical Groups II and III by Means of Guanidine Carbonate in Tartrate Solution.** A. Jilek and J. Kota (*Coll. Trav. chim. Tchécoslov.*, 1932, 4, 412-417).—Ti may be quantitatively separated from Al<sup>+++</sup>, CrO<sub>4</sub><sup>''</sup>, WO<sub>4</sub><sup>''</sup>, MoO<sub>4</sub><sup>'</sup>, UO<sub>2</sub>, Th, or AsO<sub>3</sub><sup>'''</sup> by addition of guanidine carbonate to a boiling, dilute,

neutral solution containing  $\text{NH}_4$  tartrate under certain specified conditions for details of which the original must be consulted.—A. R. P.

**On the Precipitation of Calcium by Potassium Ferrocyanide.** R. Chandelle (*Bull. Soc. chim. Belg.*, 1932, 4, 420-429).—In the presence of a large excess of  $\text{NH}_4\text{Cl}$  or  $\text{KCl}$  a crystalline precipitate is obtained on addition of  $\text{K}_4\text{Fe}(\text{CN})_6$  to a solution of  $\text{Ca}$  salt. The precipitate is  $\text{Ca}(\text{NH}_4)_2\text{Fe}(\text{CN})_6$  in the first case and  $\text{Ca}_2\text{Fe}(\text{CN})_6$  in the second.—A. R. P.

**Gasometric Determination of Chromium.** M. Couture (*Annali chim. appl.*, 1932, 10, 680-682).—The growing importance of  $\text{Cr}$  in industry demands a rapid method for the analysis of plated articles, salts, alloys, electrical resistances, &c. Such a method based on the evolution of  $\text{O}_2$  on treating  $\text{CrO}_3$  solutions with a peroxide is described.—G. G.

**Methods for Copper Determination.** N. I. Matveev (*Zvetnye Metally (The Non-Ferrous Metals)*, 1930, 1491-1505; *C. Abs.*, 1933, 27, 680).—[In Russian.] A critical review of various methods for the determination of  $\text{Cu}$  in metals. Eighty-five references are given.—S. G.

**The Potentiometric Determination of Iron and Vanadium in Ferrovandium and of Iron and Chromium in Ferrochromium.** Peter Dickens and Gustav Thanheiser (*Arch. Eisenhüttenwesen*, 1932-1933, 6, 379-388).—Various methods for the simultaneous determination of  $\text{Fe}$  and  $\text{V}$  by oxidimetric and reductometric methods are critically reviewed; the former type is preferred. Standardization of the  $\text{KMnO}_4$  with  $\text{Na}_2\text{C}_2\text{O}_4$  and with  $\text{V}_2\text{O}_5$  gives approximately the same result, but the former is more certain. The rapid method for  $\text{V}$  recently described has been applied to the analysis of ferrovandium, and a new method for the simultaneous determination of  $\text{Fe}$  and  $\text{Cr}$  is also described.—J. W.

**Colorimetric Method for the Determination of Traces of Tungsten.** F. Feigl and P. Krumholz (*Angew. Chem.*, 1932, 45, 674-675).—The solution (2 c.c.) containing the  $\text{W}$  as  $\text{Na}_2\text{WO}_4$  and 0.05-0.5N with  $\text{NaOH}$  is treated with 5 drops of 25%  $\text{KCNS}$  solution and diluted to 5 c.c. with a 10% solution of  $\text{SnCl}_2$  in  $\text{HCl}$  (*d* 1.19). After 30 minutes the yellow colour produced is compared with that of a standard prepared in a similar way from  $\text{Na}_2\text{WO}_4$  solution. The method gives results with an error of  $\pm 3\%$  for quantities of  $\text{W}$  between 10 and  $100\mu$  gm. Molybdates produce a more intense colour than tungstates under these conditions, and must therefore be removed before applying the test.—A. R. P.

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

(See also "Testing" and "Pyrometry.")

(Continued from p. 454.)

**Thermal Analysis of Alloys by the Differential Method in Inert Gas Atmospheres.** E. Alberti (*Z. tech. Physik*, 1933, 14, 281-283).—A detailed description of the construction and operation of a suitable apparatus.—J. W.

**Darkfield Illuminator.** Anon. (*Instruments*, 1933, 6, 89).—A brief description of the Leitz method of darkfield conical illumination.—J. C. C.

**Outline of a Theory of the Technique of Temperature Regulation.** Max Lang (*Z. tech. Physik*, 1933, 14, 98-105).—J. W.

**Radiation Thermopiles for Use at Liquid Air Temperatures.** C. Hawley Cartwright (*Rev. Sci. Instruments*, 1933, [N.S.], 4, 382-384).—Values of thermoelectric power against lead, the Wiedemann-Franz ratio and relative electrical conductivity at  $25^\circ\text{C}$ . and  $-183^\circ\text{C}$ . are tabulated for tellurium,  $\text{Bi} + 11\%$   $\text{Sb}$ ,  $\text{Bi} + 10\%$   $\text{Sn}$ , and Constantan. A thermoelectric pile composed of Constantan and  $\text{Bi} + 11\%$   $\text{Sb}$  alloy, operated *in vacuo*, is 10 times as sensitive at  $-183^\circ\text{C}$ . as it is at  $25^\circ\text{C}$ .—J. S. G. T.

**A Possibility of Attaining any Desired Low Temperature.** F. Simon (*Z. Physik*, 1933, **81**, 824-831).—The possibility of attaining extremely low temperatures by the adiabatic demagnetization of certain paramagnetic materials and by the adiabatic expansion of condensed substances is discussed, and apparatus for this purpose, employing liquid helium, is suggested (cf. following abstract).—J. S. G. T.

**The Attainment of Very Low Temperatures by Compression of Liquid Helium.** W. Meissner. F. Simon (*Z. Physik*, 1933, **81**, 832-837, 838-839).—Contrary to the conclusion of Simon (see preceding abstract), M. shows that temperatures below 2° abs. are to be obtained by the compression of liquid helium, and not by its expansion, as liquid helium is characterized by a temperature of maximum density. S. replies.—J. S. G. T.

**"1-2-3-5" System Weights.** Anon. (*Instruments*, 1933, **6**, 92).—The use of the series 1, 2, 3, 5, adopted for the new Sartorius weights, obviates the use of two weights of the same denomination, saves time in identifying weights, and is said to enable a single calibration correction to be applied to any combination, thus avoiding the need for correcting each weight separately.—J. C. C.

**A High-Vacuum Spectrograph for Chemical Analysis by X-Rays.** E. Alexander (*Z. Physik*, 1933, **83**, 512-516).—A spectrograph characterized by two values of dispersion and permitting exposures to be made within an angular region of 120° is described.—J. S. G. T.

## XI.—PHYSICAL AND MECHANICAL TESTING AND RADIOLOGY

(Continued from pp. 455-456.)

**Report of Committee E-1 [of A.S.T.M.] on Methods of Testing.** W. N. Fulweiler and R. E. Hess (*Amer. Soc. Test. Mat. Preprint*, 1933, 1-7).—A summary of work done by the various sections of the Committee during the year. These have been concerned principally with tension testing (*Proc. Amer. Soc. Test. Mat.*, 1932, **32**, (1), 945, see *J.*, this volume, p. 374), compression testing (see abstract below), indentation hardness, testing thin sheet metals, impact testing, effect of speed of testing, elastic strength of materials, calibration of testing machines, flexure testing, plasticity and consistency, particle size and shape, sieve sizes, measurement of thickness, and interpretation and presentation of data. Among other definitions proposed are—*Consistency*—that property of a material other than a gas by virtue of which it resists the stresses which produce permanent change of shape. *Consistency* is expressed by the three following flow-force relations—*Simple (Newtonian) liquid*, when the ratio of flow to force in the material is constant. *Solid*—any body which requires a finite stress to produce a permanent deformation. *Non-Newtonian liquid*—a body which yields permanently under very small stresses and yet is not a simple liquid. *Plasticity* is that property of a solid by virtue of which it is permanently deformed when stressed above the yield value. Factors which define plasticity are the yield value and the mobility. *Yield value* 0—the minimum stress required to produce a permanent deformation in a solid. *Mobility*  $\mu$ . The coeff. in the law of plastic flow  $v = \mu(F - 0)r$ , where  $v$  is velocity imparted by stress  $F$  per unit area, to either of two parallel planes separated by the distance  $r$ , the space between the planes being filled with the plastic material.—W. A. C. N.

**Correspondence on Testing of Castings.** W. Rosenhain (*Rev. Mét.*, 1933, **30**, 117).—W. R. points out an error in the report of the Zürich Congress of the International Association for Testing Materials, as given in *Rev. Mét.*, 1932, **29**, 308, which states that the unanimous opinion of the metallurgists of the world was strongly opposed to the use of test-pieces cut from the castings

themselves. The official summary of the discussion mentions that two different points of view were expressed. Representatives of Belgium, Czecho-Slovakia, Germany, Great Britain, Holland, Switzerland, and the U.S.A. spoke with favour of the use of specially cast test-pieces, whilst the representative of France put forward the method of testing small pieces cut from the castings themselves.—H. S.

An "Overnight" Test for Determining Endurance Limit. H. F. Moore and H. B. Wishart (*Amer. Soc. Test. Mat. Preprint*, 1933, 1-7; and (abstract) *Iron Age*, 1933, 132, 32n).—The principle of the test is that below the endurance limit cycles of repeated flexure increase the endurance limit and presumably the tensile strength, whilst above the endurance limit cracks begin to develop, and reduce the tensile strength. A period of about 1,400,000 cycles appears to be sufficient to develop such cracks for the materials tested. The Rockwell hardness of the specimens is determined. They are then subjected to the specified number of cycles of stress in a rotating beam machine, which usually requires some 15-16 hrs. After this the specimens are pulled as tension specimens. Those breaking before the end of the 1,400,000 cycles are credited with zero tensile strength. Making corrections proportional to the hardness figures, the data are plotted, with the stresses applied for 1,400,000 cycles as ordinates and tensile strength after this period as abscissæ. The endurance limit is taken as the ordinate corresponding with the maximum abscissa on this curve. The test has been checked for a variety of ferrous and non-ferrous materials. The maximum variation from the results of long period tests was in the case of Duralumin — 11.8%.—W. A. C. N.

Proposed Revision of Tentative Accelerated Life Test for Metallic Materials for Electrical Heating (B 76-29 T). — (*Amer. Soc. Test. Mat. Preprint*, 1933, 7-8).—Appendix to Report of Committee B-4 on Electrical-Heating, Electrical-Resistance, and Electric-Furnace Alloys (see *J.*, this volume, p. 493). A list of a few general considerations and precautions which should be borne in mind in setting up and operating the life test equipment, and in carrying out the technique. Temperature is one of the most important variables to be considered, the life of a wire varying inversely with an exponential function of this factor. It can be measured by means of a modified disappearing filament type of optical pyrometer. The voltage must be carefully controlled. No general rule will indicate the limit for the useful life of a heating element. —W. A. C. N.

Proposed Revised Tentative Methods of Compression Testing of Metallic Materials. — (*Amer. Soc. Test. Mat. Preprint*, 1933, 8-16).—Appendix to Report of Committee E-1 on Methods of Testing (see *J.*, this volume, p. 516).—In performing these tests the speed of the cross head of the machine when the machine is running idle shall be such that the load can be accurately weighed. In no case should the speed exceed 0.05 in./minute for a specimen 1 in. in length or 0.10 in./minute for specimens 3 in. long or over. In testing elastic limit in compression the cross-head speed should conform to the requirements of the corresponding tension test of the material. Test-specimens should be cylinders with plane ends and smooth surfaces, and of the following dimensions: short, for compression tests on bearing metals,  $1\frac{1}{2}$  in. diam. and 1 in. long; medium, for determining general compressive strengths of metallic materials 0.798 in., 1 in., or  $1\frac{1}{2}$  in. diam. and  $2\frac{3}{8}$  in., 3 in., or  $3\frac{3}{8}$  in. long, respectively; long, for determining the modulus of elasticity in compression,  $1\frac{1}{2}$  in. diam., and  $12\frac{1}{2}$  in. long. Variations of  $\pm 0.01$  in. are allowable on the diam. The bearing blocks should be provided with machined plane surfaces. The upper end of the specimen shall bear a spherical seated compression block. A diagram of a suitable arrangement is given, followed by a description of the procedure to be followed. Finally, standard definitions of elastic limit, and yield-strength are included, together with details of the "drop of

the beam," "total strain," and "set" methods of determining the yield-strength.—W. A. C. N.

**A New Method of Determining the Modulus of Elasticity of Materials.** P. Le Rolland and P. Sorin (*Rev. Mét.*, 1933, 30, 112-116).—The method described consists in supporting upon the specimen two identical oscillating systems (gravity pendulums) and observing the time which elapses between successive periods of rest which are observed in both pendulums at intervals following commencement of oscillation in one of them.—H. S.

**An Industrial, Mechanically Recording Extensometer.** Pierre Chevenard (*Rev. Mét.*, 1933, 30, 85-95).—The relative displacement of two points on the test-length is amplified by a lever and recorded on a drum which turns through an angle proportional to the tensile stress. Use of the extensometer at elevated temperature is described.—H. S.

**Dynamic Extensometers and Oscillographs for Investigating the Rolling Process.** Hubert Hoff and Theodor Dahl (*Stahl u. Eisen*, 1933, 53, 593-604).—The advantages of oscillographs and of extensometers on the condenser principle in investigating the rolling process are mentioned, and a new apparatus is described for the exact determination of the number of revolutions of the rolls and the amount of slip.—J. W.

**The Significance of the Results of Short-Time High-Temperature Tension Tests.** H. F. Moore, J. W. Bolton, and J. J. Kanter (*Amer. Soc. Test. Mat. Preprint*, 1933, 17).—Appendix III to Report of Joint Research Committee [of A.S.T.M. and A.S.M.E.] on Effect of Temperature on the Properties of Metals (see *J.*, this volume, p. 486). So far no correlation between the results of short-time high-temperature tension tests and slow creep at high temperatures has been found. There is also no evidence of any relation between these tests and those on fatigue strength. Where the phenomena of creep are not very important, however, as when a metal is exposed to occasional short periods of high temperature, the results of the short-time and high-temperature tests have some significance. The yield strength is a reasonable index of the resistance to permanent distortion under such occasional short-time loads. In general, it may be said that short-time high-temperature tests have a narrower field of usefulness than short-time tests at room temperature.—W. A. C. N.

**Proposed Tentative Method of Test for Short-Time High-Temperature Tension Tests of Metallic Materials.** — (*Amer. Soc. Test. Mat. Preprint*, 1933, 18-25).—Appendix to Report of Joint Research Committee [of A.S.T.M. and A.S.M.E.] on Effect of Temperature on the Properties of Metals (see *J.*, this volume, p. 486). The method covers tests within the range from room temperature up to 2000° F. (1090° C.). The surface of the test piece shall be smooth and free from scratches, and its dimensions those of the ordinary 2-in. standard specimen. The type of testing machine used must be reported with the test. Details of the heating furnace design are specified. A summary of the data which are necessary in completing a satisfactory test is given.—W. A. C. N.

**Proposed Tentative Method of Test for Long-Time (Creep) High-Temperature Tension Tests of Metallic Materials.** — (*Amer. Soc. Test. Mat. Preprint*, 1933, 26-34).—Appendix to Report of Joint Research Committee [of A.S.T.M. and A.S.M.E.] on Effect of Temperature on the Properties of Metals (see *J.*, this volume, p. 486). The method covers high-temperature creep tests at temperatures up to 1090° C. The temperature ranges that should be investigated in the case of a variety of metals are given. In the case of copper and aluminium alloys, this is 300°-300° F. (150°-430° C.). The constant-temperature constant-stress method is employed. Stresses to produce creep at the rate of 1.0% per 10,000 hr. and 0.1% per 10,000 hr. in the secondary flow period are to be determined. Details of procedure are included.—W. A. C. N.

**The Determination and Significance of "Proportional Limit" and "Breaking Strength" in Short-Time High-Temperature Tests.** H. F. Moore, J. W. Bolton, and J. J. Kanter (*Amer. Soc. Test. Mat. Preprint, 1933, 10-16*).—Appendix II to Report of Joint Research Committee [of A.S.T.M. and A.S.M.E.] on Effect of Temperature on the Properties of Metals (see *J.*, this volume, p. 486). The determination of proportional limit is indefinite unless details of equipment and the method of tabulation of the results are specified. Except possibly for breaking strength at high temperatures, the results for proportional limit show a wider variation than any other test. It is quite possible that from the start of a test there is some departure from the normal straight-line relation, on account of uneven deformation of individual crystals in the material, and proportional limit is merely the value for which the aggregate of such action becomes detectable with the particular apparatus used. There is no logical or experimental basis for assuming the absolute identity of proportional limit and elastic limit for first permanent set. Various typical stress-strain diagrams and their significance are discussed. Even a very delicately determined proportional limit for a metal has little definite significance as an index of strength or weakness, whereas a fairly well-defined yield-strength does indicate the limiting stress below which serious structural damage due to permanent distortion will not occur. Preliminary data indicate that, for one of the materials used, some creep can be detected at stresses lower than any proportional limits determined in the short-time tests. There is no evidence at the present time that short-time proportional limit tests are a reliable index for creep strength of a metal at high temperature. There is some indication that, for some metals at least, large grain-size is of advantage in resisting creep. The determinations of proportional limit and of breaking strength have been omitted from the tentative method for short-time high-temperature tension tests.—W. A. C. N.

**Studies on a Modification of the Rohn Test for Investigating Creep of Metals.** C. R. Austin and J. R. Grier (*Amer. Soc. Test. Mat. Preprint, 1933, 1-15*).—A discussion of experiences with a test method intended as a rapid means of classifying alloys as to their metallurgical behaviour and probable utility for use in mechanical service at high temperatures. The construction of the special furnace is described. In this particular type of test the following factors have to be considered carefully and allowed for: coeff. of expansion of the test rod and the changes in elastic modulus and temperature gradients. The test rod is about a metre long, and is itself used as a kind of dilatation thermometer, effecting the automatic regulation of the temperature by changes in its own length. A. and G. have superimposed an intermittent mechanical make and break on the original Rohn apparatus which has resulted in the elimination of marked temperature fluctuations.—W. A. C. N.

**Proof Stress: An Historical Note.** Wesley Lambert (*Met. Ind. (Lond.)*, 1933, 43, 26).—The "proof stress" test, which allows a maximum permanent extension of 0.003 in. on a 2-in. gauge-length, is identified with the "permanent set" test and is traced back about 50 years. Some doubts of the practical convenience of the test are expressed.—J. H. W.

**The Testing of Hardness in Metals.** Anon. (*Indian Railway Gazette*, 1932, 33, 162-163).—Hardness testing methods are classified into "scratch" and "penetrative" tests, the latter being subdivided according as the penetration is percussive or produced by pressure. The "pendulum" method and some recent modifications of the Brinell test are briefly described.—P. R.

**Recorder-Controller for Materials Testing Machines.** Anon. (*Instruments*, 1933, 6, 90-91).—An illustrated account of the Southwark-Emery stress-strain recorder-controller, by means of which a tensile testing machine can be automatically operated either to apply constant rates of straining or of loading or to maintain a constant load.—J. C. C.

**Proposed Tentative Methods of Verification of Testing Machines.**—(*Amer. Soc. Test. Mat. Preprint*, 1933, 17-28).—Appendix to Report of Committee E-1 on Methods of Testing (see *J.*, this volume, p. 516). Certain definitions of error, percentage of error, correction, tolerance, loading range, and of an elastic calibration device are first given. There follow details of methods for verifying testing machines that measure load, for applying the load, for selecting the test loads, and for correcting eccentricity of loading. The various methods of verification are very carefully examined and their limitations summarized.—W. A. C. N.

**Proposed Tentative Method of Analysis for the Particle Size Distribution of Sub-Sieve Size Particulate Substances.**—(*Amer. Soc. Test. Mat. Preprint*, 1933, 29-35).—Appendix to Report of Committee E-1 on Methods of Testing (see *J.*, this volume, p. 516). As far as the shape of the particle will permit, the size is determined in absolute units. The method is applied to homogeneous materials; its application to mixtures is limited by the properties of the components. The range of sizes covered is between 72-micron and 0.2 micron. Preliminary separation into groups of sizes may be necessary where wide ranges are being examined, in order to facilitate measurement under the microscope. Definitions of the following terms as used in the paper are given: dispersion, individual particle, aggregate, ultimate working unit, flocculation, and average diameter. Separation into size groups is obtained by elutriation using a fluid which is completely volatile and does not react chemically with the solids. In mounting the samples care should be taken that the particles are in one plane, free from motion, so dispersed as to show individual particles, unaffected by grinding during mounting and in a medium which gives maximum definition. For measurement the methods used were: (1) by direct observation using the Filar micrometer; (2) by projection, involving the throwing of an image of the particle on a screen; (3) by photomicrography and subsequent measurement of the particles on a print. In all instances the average horizontal diameter should be measured. Two hundred and fifty particles in each of three fields, taken at random, are measured. For all elutriated samples weight distribution is the basis of comparison. If 90% by weight, however, fall into one class size a frequency curve suffices.—W. A. C. N.

### RADIOLOGY

**On the Measurement of Stresses by X-Rays.** H. Möller (*Z. tech. Physik*, 1933, 14, 217-220).—The changes which occur in the interference lines of the X-ray spectrogram during homogeneous and heterogeneous elastic deformations, the determination of the state of stress by precision measurements of the distances between the lattice planes, and the accuracy obtainable by the use of standard substances are described.—J. W.

**Gamma-Rays to Insure Internal Soundness.** Dartrey Lewis (*Metal Progress*, 1933, 24, (1), 29-31).—Gamma-rays may, on account of their greater penetrating power, advantageously supplement X-rays in the detection of internal flaws, especially in such dense materials as bronze and iron. They are especially applicable, on account of their relatively slight tendency to scatter, to the examination of irregularly shaped sections. The portability of radium facilitates the process, but the time necessary for exposure is a serious disadvantage. Costs, manipulation, and protective measures are briefly reviewed.—P. M. C. R.



## XII.—PYROMETRY

(Continued from p. 457.)

**Principles and Applications of Pyrometry.** S. F. Godfrey (*Western Gas*, 1932, 8, (11), 25-26; *C. Abs.*, 1933, 27, 638).—Temperature measurement in industry is reviewed, and the fundamental features of practical thermocouples are described. Pure metals and uniform alloys must be used for thermocouples. Various types of instruments for measuring the e.m.f. generated are described, and the calibrated galvanometer is compared with the potentiometer type.—S. G.

**Anti-Hunting Device for Pyrometric Control.** Anon. (*Instruments*, 1933, 6, 102).—The "Deoscillator" introduces a small e.m.f. into the pyrometer circuit which augments the thermocouple e.m.f. when the indicator is below the control point and opposes it when the reading is "high." As a result, on a rising temperature the heat input is decreased just before the desired point is reached, and on a falling temperature it is increased just above the control point. Thus the instrument anticipates the return to normality and tends to prevent "overshooting."—J. C. C.

## XIII.—FOUNDRY PRACTICE AND APPLIANCES

(Continued from pp. 457-458.)

**Report on World Foundry Congress, Paris, Sept. 13-18, 1932.** F. Renaud (*Rev. Mét.*, 1933, 30, 212-221).—Reviews of leading papers are given. A. Portevin surveys recent work on "castability" of metals and alloys. Castability varies inversely with the solidification interval, is greatest for pure metals, eutectics, and maximum points on the liquidus, and minimum for saturated solid solutions. It depends on the form of solidification and is relatively much greater when the liquid deposits convex crystals of definite composition than when dendrites are formed.—H. S.

**Non-Ferrous Foundries in Germany.** Erich Weiss (*Met. Ind. (Lond.)*, 1933, 42, 657-658).—A brief description of details in which non-ferrous foundries in Germany differ from similar foundries in England, and of general procedure.—J. H. W.

**Gases and Shrinkage.** Anon. (*Metallurgist (Suppl. to Engineer)*, 1933, 9, 33-34).—A discussion referring to the bad effects of gas cavities in castings, the larger shrinkage resulting from the use of gas-free metal, and the undesirability of avoiding casting difficulties by the use of gas-bearing metals in place of modified casting methods.—R. G.

**Sand-Casting "Hiduminium" Alloy.** Anon. (*Met. Ind. (Lond.)*, 1933, 43, 31).—Short note on the casting and mechanical properties of alloy "R.R.53," taken from a data sheet issued by the manufacturers.—J. H. W.

**The Practical Deoxidation of Brasses and Bronzes.** Fernando González V. (*Rev. quim.*, 1932, [N.S.], 1, (4), 9-12; *C. Abs.*, 1933, 27, 1853).—Reduction of dissolved cuprous oxide by the addition of a copper-manganese-aluminum alloy to the molten metal is described and discussed.—S. G.

**Deoxidizing Brasses.** W. Broniewski and — Lewandowski (*Rev. Fonderie moderne*, 1933, 27, 175-182).—The deoxidation of brasses containing 33-40% zinc have been studied by comparing the mechanical properties of an undeoxidized alloy with alloys treated with one of 13 deoxidizers (Al, B, Be, Cu, Mn, Mg, P, Si, Ti, V, 2Al-Si, and 1Al-Ca-Si alloy), added to the extent of 0.3%. The mechanical properties were measured for each alloy in the annealed and the cold-worked states. For the 33:66 brass, the best results were obtained when the alloy was not deoxidized during melting,

pure metals being used. Of the deoxidizers, aluminium, and particularly Alpac, gave the best results. Magnesium, and, especially, phosphorus are distinctly harmful. For the 40 : 60 brass, the best results were also obtained by using pure metals, and by deoxidizing with silicon alloys, especially the 50% aluminium alloy. Phosphorus is very harmful. In general, the practice recommended is to melt in an atmosphere rendered strongly reducing by carbon; attempts to deoxidize oxidized brass are not satisfactory, but the best results are obtained by the use of aluminium-silicon alloys.—J. H. W.

**Centrifugal Bronze Gear Blanks.** Francis W. Rowe (*Metal Progress*, 1933, 23, (6), 15-19).—The structure and properties of the eutectoid constituent of the bronzes are described and illustrated; the good anti-frictional properties of these alloys are attributed to the presence of the hard eutectoid embedded in a comparatively soft matrix. The effects of small additions of lead, phosphorus, and nickel are discussed. A description is given of the development of casting methods designed to secure the increased strength demanded by modern conditions without affecting the essential bearing structure; and a tabulated comparative summary gives the mechanical properties of worm-wheel blanks of two sizes, prepared by the following methods: sand-cast, ring chill-cast, three-sided chill-cast, centrifugally cast. The last is found to give the closest and most nearly uniform structure, with the minimum of unsoundness.—P. M. C. R.

**Report of Committee B-6 [of A.S.T.M.] on Die-Cast Metals and Alloys.** H. A. Anderson and P. V. Faragher (*Amer. Soc. Test. Mat. Preprint*, 1933, 1-7).—In aluminium-base alloy die-castings the copper content in alloy No. XII is reduced to 6.0-8.0%, the range of silicon content increased to 3.5% (max.), and the zinc increased to 1.5%. A comparison is made between two well-known zinc-base die-casting alloys known as XXI and XXIII. The latter is being used the more extensively. A useful discussion on the manner in which test data should be published is included. An additional sub-committee is considering magnesium-base die-casting alloys.—W. A. C. N.

**Die-Castings in Aluminium-Bronze.** H. Bentley (*Met. Ind. (Lond.)*, 1933, 43, 52).—Short account of the application of "aluminium-bronze" to die-casting.—J. H. W.

**Foundry Cores.** Anon. (*Foundry*, 1932, 9, 446-452).—The requisite properties of a good core are enumerated, and methods of manufacture, drying, and binding are described.—G. G.

**Colbond in the Foundry.** J. Thompson (*Found. Trade J.*, 1933, 48, 417).—Colbond, a definite natural mineral entity, is said to have the following advantages over naturally bonded sands: (1) less moisture required; (2) easier mixing; (3) maximum spreading of the bond through the sand; and (4) the costs of transport and storage are only 10% of those of naturally bonded sands.—J. H. W.

**Cement Moulds in the Foundry.** Louis Maillard (*Rev. Mét.*, 1932, 29, 605-612).—Data are given on the permeability of cement-sand moulds. Typical applications of the moulds are described.—H. S.

**Some Experiments with Routine Sand Testing of Green Sand.** John Hird (*Found. Trade J.*, 1933, 48, 426-427).—Describes the apparatus and methods of making routine tests of green sand and gives typical results and the method of reporting them.—J. H. W.

**Sand Testing in the Foundry.** Wm. Y. Buchanan (*Found. Trade J.*, 1933, 49, 38).—Abstract of matter not previously published in this *Journal* from a paper read before the Polish Foundrymen's Association. Describes the testing of sand for density, green strength, and permeability. See *J.*, this volume, pp. 327, 382.—J. H. W.

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

(Continued from p. 458.)

**Utilization of Copper Waste.** N. P. Sosnovskii (*Gorno-Obogatitelnoe Delo*, 1932, (7/8), 81-85; *C. Abs.*, 1933, 27, 3176).—[In Russian.] Methods of recovery of copper from factory waste containing 4% copper are discussed.

—S. G.

**Industrial Profit in Tin Cans.** Santos Miyara (*Requind.*, 1932, 2, 11-15; *Rev. quim.*, 1932, [N.S.], 1, (7), 11-15; *C. Abs.*, 1933, 27, 3177).—The following methods used for tin recovery from tin cans, &c., are reviewed: heating; extraction with solutions of acids, alkalis, &c.; chlorination, and electrolysis.

—S. G.

## XV.—FURNACES AND FUELS

(Continued from p. 458.)

**Heat-Treatment Furnaces.** Anon. (*Automobile Eng.*, 1933, 23, 215-218 and 241-244).—Recent improvements in automatically controlled furnaces are considered, particularly with reference to their use in the automobile industry for the heat-treatment of complex alloy steels and special aluminium alloys. Among the types of furnaces dealt with are electric resistance double-deck furnaces for hardening and tempering, low-temperature electric furnaces with or without forced air circulation, conveyor furnaces of the belt type suitable for use with a neutral or reducing atmosphere, multiple purpose electric furnaces used for a variety of purposes, and gas furnaces which include both normalizing and carburizing furnaces of the continuous and continuous automatic type. All the furnaces are dealt with in considerable detail, and the control equipment and methods of operation are fully considered.—J. W. D.

**Foundry Furnaces [Fired] by Heavy Oil.** Ch. Dennery (*Usine*, 1931, 40, (46), 29-31).—A long abstract of a paper read before the Association Technique de Fonderie. The particular properties of oil as a fuel and the methods of its application are explained. Various types of melting furnaces are described.—H. W. G. H.

**Theory of the Electric Arc Furnace.** A. I. Kholodov (*Domez*, 1932, (6), 50-61).—[In Russian.] Mathematical.—S. G.

**The High Frequency Furnace in Theory and Practice for High Temperature Use.** W. Esmarch (*Z. tech. Physik*, 1932, 13, 590-591).—A short review of the theory of high-frequency induction furnaces with an account of their method of operation and some of their uses. Very high temperatures may be obtained by heating sintered tungsten in the furnace. (Cf. *J.*, 1931, 47, 613, and *Z. Elektrochem.*, 1932, 38, 812.)—J. W.

**Induction Furnaces.** P. Bunet (*Congrès internat. d'Élect.*, Paris, Sect. 7, Rapport No. 11, 1932, 1-25).—Cf. *J.*, this volume, p. 271. Following a brief historical review, present practice in induction furnaces is discussed. Power factor, choice of frequency, cooling of primary winding and regulation, disadvantages of exterior flux and high operating voltage, &c., receive detailed attention, and the action of small-power furnaces energized by the intermittent discharge of a condenser is described.—S. G.

**A Vertical, Vacuum, Split-Tube, Graphite-Resistance Furnace.** Robley D. Evans (*Rev. Sci. Instruments*, 1933, (N.S.), 4, 391-393).—By splitting the graphite resistor tube of a vertical, evacuated, high-temperature furnace, the construction is simplified, resistor breakage is prevented, and the zone of highest temperature is brought deeper in the furnace than is the case with spiral or solid tube types of vertical furnace. The construction of the

furnace cover allows crucibles to be put into, or removed from, the furnace without breaking the main vacuum seal. The melt can be observed, and the gases can be drawn off to other apparatus. The furnace attains 2000° C. on 7-kw. power input.—J. S. G. T.

**Low Cost and High Quality in Electric Furnaces.** H. M. Webber (*Metal Progress*, 1933, 23, (5), 34-37).—Quality of the product should receive equal consideration with the question of the overall cost of any heat-treating process. Accurate control of temperature, of furnace atmosphere and of heating and cooling speeds, and uniform distribution of heat, are shown to be important factors in determining quality, and modern types of equipment designed to emphasize these factors are described and illustrated.—P. M. C. R.

**The Electric Furnace and Its Products in the U.S.S.R.** C. H. Vom Baur (*Electrochem. Soc. Preprint*, 1933, May, 391-394).—By the end of next year 449 electric furnaces, mainly for steel production, will be installed in Russia. Brief details of the distribution of these between the various types are given with some record of their capacities.—A. R. P.

**Electric Heating in Industry.** — Michaelis (*Elekt. Betrieb*, 1931, 29, 97-101; *Sci. Abs.*, 1932, [B], 35, 71).—M. enumerates the uses in the various industries of arc, induction, and resistance furnaces, and pays special attention to the last named. Details are given of the uses of resistance furnaces for drying purposes, heat-treatment of metals, &c. Comparative costs are given for coal, gas, and electricity, with details from a brass foundry, steel treatment, and bright-annealing.—S. G.

**Electric Melting of Aluminium.** Anon. (*Metallurgist (Suppl. to Engineer)*, 1932, 8, 180-181).—A brief review, referring mainly to information given by E. Fr. Russ in *Metallwirtschaft*, 1932, 11, 593-594. See *J.*, this volume, p. 155.—R. G.

## XVI.—REFRACTORIES AND FURNACE MATERIALS

(Continued from pp. 354-353.)

**Report of Committee C-S [of A.S.T.M.] on Refractories.** G. A. Bole and C. E. Bales (*Amer. Soc. Test. Mat. Preprint*, 1933, 1-6).—A Refractories Manual containing a complete set of standard specifications and methods of testing refractory materials has been issued. Methods for determining the compression and flexural strength and the shrinkage of high-temperature heat-insulating materials are suggested. In testing the softening point of fireclay brick the base of the test cone should be embedded 3 mm. in the plaque. The section on slagging attempts to correlate slag-test data with performance in service.—W. A. C. N.

**Refractories.** J. C. Green (*Found. Trade J.*, 1933, 48, 354; discussion, 208-209).—The requirements of high-grade refractories are considered, and the need for using good-quality materials in the manufacture of firebricks and of efficient firing of siliceous refractories is emphasized. The present position of the refractory question in the foundry, and in particular repairs of cupola linings, are discussed. The use of cement guns is suggested for placing material, and the whole question of patching is considered. In the discussion, C. H. Kain gave reasons for the recent improvements in silica refractories and remarked on the unsatisfactory nature of setting cements. V. C. Faulstich stressed the importance of the conductivity of bricks. A. W. G. Bagshawe sought co-operation between the gas industrialist and the refractory manufacturer and commented on the economic side of the question. G. replied.—J. H. W.

**Tercod—A New Refractory Brick for Electric Furnaces.** G. S. Diamond (*Electrochem. Soc. Preprint*, 1933, May, 323-326).—The brick consists of silicon carbide with or without a proportion of graphite bonded with carbon

and glazed with a borosilicate flux to prevent oxidation; it has a coeff. of thermal expansion only one-ninth of that of silica brick and less than half that of ordinary carborundum brick. The brick resists abrasion at 1350° C. and suffers no less by spalling in 10 cycles at 1350° C. in an air blast; it has a modulus of rupture of 478 lb./in.<sup>2</sup> at 1350° C., a porosity of 18%,  $d$  2.1. specific heat 0.18, thermal conductivity 110 B.t.u./ft.<sup>2</sup>/hr./in./1° F., coeff. of thermal expansion 0.000027, and electrical resistivity 0.009125 ohm/cm.<sup>3</sup> at 816° C. and 0.006625 ohm/cm.<sup>3</sup> at 1482° C. Tercoed brick resists acid or neutral slags at all temperatures, but is readily attacked by basic slags; it can be used for lining Detroit electric furnaces for melting copper, brass, and (if glazed with alumina instead of the borosilicate flux) nickel.—A. R. P.

**Alumina as a Highly Refractory Material.** H. Gerdien (*Z. tech. Physik*, 1932, 13, 586-590).—Crucibles and other laboratory apparatus made of pure alumina consist, after sintering, of pure  $\alpha$ -corundum and have practically the same properties as natural corundum; they are highly resistant to reducing agents, good insulators, gas-tight up to 1700° C., and, owing to their high heat conductivity, insensitive to sudden temperature changes. The chemical behaviour of sintered corundum and some of its technical uses are described (cf. *J.*, this volume, pp. 273, 329).—J. W.

**Magnesite Bricks Insensitive to Temperature Changes.** K. Endell (*Technique moderne*, 1933, 25, 357).—Abstract from *Stahl u. Eisen*, 1932, 52, 759-763. See *J.*, this volume, p. 211.—R. B. D.

**Effect of Manufacturing Process of Magnesia Refractories on their Hydration.** Masaji Kajiwara (*J. Japan. Ceram. Assoc.*, 1931, 39, 433-435; *C. Abs.*, 1933, 27, 1124).—[In Japanese.] A dead-burned magnesite composed of SiO<sub>2</sub> 3.52, Al<sub>2</sub>O<sub>3</sub> 0.99, Fe<sub>2</sub>O<sub>3</sub> 5.85, CaO trace, MgO 90.52, and MnO 0.56% has been made by firing a dried slurry prepared by grinding a caustic burned magnesite and a siliceous pyrite cinder with water. The crystals of periclase were one-third to one-half the size of those in an Austrian product. It was, however, far more resistant to the action of slaking. The effects of the fineness of the slurry, the time of storing, and the rate of heating are discussed.—S. G.

**Proposed Tentative Methods of Testing High-Temperature Heat Insulation (Compression Flexure Shrinkage).** (C-33 T.) — (*Amer. Soc. Test. Mat. Preprint*, 1933, 7-11).—Appendix to Report of Committee C-8 on Refractories (see *J.*, this volume, p. 524). In the compression test the specimen should be half a brick (approx.  $4\frac{1}{2} \times 4\frac{1}{2} \times 2\frac{1}{2}$  in.), having true parallel planes. The usual precautions in the setting of the test-piece in the testing machine should be taken. The speed of loading should not exceed 0.05 in. per minute, and the specimen should be compressed to a deformation of 5% of the original thickness, provided failure has not previously occurred. In flexure testing the knife edges on which the specimen rests should be as long as the width of the brick, and spaced 7 in. apart. Shrinkage is to be determined after maintaining the standard specimen at the maximum appropriate temperature for 5 hrs, and then allowing it to cool to 260° C. Volume shrinkage is calculated from the change in dimensions along the three major axes.—W. A. C. N.

**Thermal Expansion of Refractory Bricks.** Seiji Kondo and Akitaro Mannami (*J. Japan. Ceram. Assoc.*, 1931, 39, 576-581; *C. Abs.*, 1933, 27, 1124).—[In Japanese.] The linear expansion of Japanese refractory bricks was determined. The shrinkage temperatures of grog brick, agalmatolite brick, and silica brick were 1153°-1285°, 1090°-1240°, and 1504° C., respectively, and their mean coeff. of expansion from room temperature to the shrinking temperatures were 0.000046-0.000073, 0.000051-0.000066, and 0.0000489, respectively. The results of experiments in which linear expansion

was determined under a small load by a special apparatus up to 1550° C. are described.—S. G.

**Thermal Conductivity of Refractory Bricks.** Seiji Kondo and Hiroshi Yoshida (*J. Japan. Ceram. Assoc.*, 1931, 39, 657-663; *C. Abs.*, 1933, 27, 1124).—[In Japanese.] The thermal conductivities of refractory bricks, building bricks, and an insulation brick were determined by means of a small water calorimeter. The mean values at different temperatures up to about 1200° C. are shown in tables and diagrams. The conductivities increase steadily with increase of temperature except in magnesia and chrome refractories. The mean conductivities in grm. cal./cm./° C./second are given.

—S. G.

**Conduction of Heat in Powders.** W. G. Kannuliuk (*Proc. Roy. Soc.*, 1933, [A], 141, 144-158).—A description is given of a hot-wire method of determining the thermal conductivity of powders in gases, and results are given for glass spheres, diphenylamine, magnesium oxide, and a series of graded carborundum powders immersed, in turn, in air, hydrogen, carbon dioxide, and, in some cases, in helium. The conductivities were measured over the pressure range 0.5-76 cm. of mercury. The conductivity,  $k$ , is related to the pressure,  $p$ , by the equation  $p/k = ap + b$ .—J. S. G. T.

## XVII.—HEAT-TREATMENT

(Continued from p. 388.)

**Some Present Questions of Furnace Operation in the Annealing of Metals.** V. Paschkis (*Z. Metallkunde*, 1933, 25, 93-95, 117-121).—Chiefly theoretical considerations on the factors controlling the heat consumption and the possibility of heat economy for which the original paper must be consulted. The control and regulation of temperature, and the accuracy and sources of error of temperature measurements are also discussed.—M. H.

## XVIII.—WORKING

(Continued from pp. 388-393.)

**Dimensions, Materials, and Lubrication of Bearings of Rolling Mills.** A. Kretzler (*Rev. Mét.*, 1932, 29, 613-618).—A practical review of the subject, with special reference to design and operating features.—H. S.

**Simplified Methods of Calibration for the Rolling of Non-Ferrous Metals.** O. Emicke (*Z. Metallkunde*, 1933, 25, 127-131; discussion 132).—Describes the control of calibration for rough and finish rolling of non-ferrous metals and alloys, especially of wires of 6-20 mm. in diameter, by means of simple graphic methods.—M. H.

**Making Aluminium Foil.** H. Obermüller (*Met. Ind. (Lond.)*, 1933, 43, 32).—See also *J.*, this volume, p. 376. A brief account of the manufacture of aluminium foil.—J. H. W.

**Machining Aluminium.** W. B. Francis (*Met. Ind. (N. Y.)*, 1933, 31, 158).—Hints on tools for turning and drilling aluminium.—A. R. P.

**Progress in Machine Shop Practice.** — (*Amer. Soc. Mech. Eng. Preprint*, 1932).—Report of the Committee of the Machine Shop Practice Division of the American Society of Mechanical Engineers. Deals with advances made in welded structures, die-casting, material handling facilities, precision grinding machines, die cutting and engraving machine, gear generating machinery, and drop forging hammers.—W. P. R.

**Modern Methods of Production of Small Machined Work.** W. Fish (*Mech. World*, 1931, 89, 154-155).—A brief abstract of a paper read before the Junior Institution of Engineers. The growth of the electrical, motor, and wireless trades has created a demand for large quantities of small machined and pressed

parts. For example, a 3-valve wireless receiver includes possibly 2000 components, the total manufacturing cost of which must be kept down to 20s. or 30s. Although brass screws  $\frac{3}{8}$  in. long under head can be produced at the rate of one in  $2\frac{1}{2}$  seconds, efforts are being made to lessen time lost in feeding, by feeding coiled wire instead of straight bars, and it is hoped that the metallurgist will discover materials which will machine more easily without suffering in physical properties.—F. J.

**What Can Be Accomplished with Modern Machine Tools and Cemented Carbide Cutting Tools.** Arthur A. Merry (*Amer. Soc. Mech. Eng. Preprint*, 1932, Dec., 1-6).—In order to show the possibilities of cemented carbide tools, tests are described which were carried out on a lathe specially built for this purpose. The lathe is driven by a 100-H.P. motor, and the maximum speed is 1200 r.p.m. with such equipment cemented carbide tools removed 161 cu. ins. of nickel steel per minute. In one special test a single pointed tool removed material at the rate of  $1\frac{1}{2}$  tons per hr.—W. P. R.

**Grinding Cemented Tungsten- and Tantalum-Carbide-Tipped Tools Economically.** J. M. Highducheck (*Amer. Soc. Mech. Eng. Preprint*, 1932, Dec., 1-4).—Localized heating of a carbide-tipped tool causes cracking. Soft grinding wheels should be used, but the wheel should have sufficient strength to prevent its breaking down. In order efficiently to rough-grind clearance angles on tungsten carbide tool, it is necessary that the contact surface between the tool and the grinding wheel be a line and not a surface.—W. P. R.

**Hard Metals in Drilling.** M. B. Together (*Allgem. Österr. Chem. Tech. Zeit.*, 1932, 50, 223-225, 235-237).—The structure and properties of hard metals containing tungsten carbide and their use in drilling are described.

—A. R. P.

**Recommendations for the Selection of Metal Working Oils.** K. Kreckler (*Schweiz. Verband für die Materialprüfungen der Technik, Diskussionsber.*, No. 24, 1932, 19-22).—The properties of oils and oil emulsions for use in drilling, turning, and drawing metals are discussed. Addition of graphite has no effect whatever on the power required in drawing wire.—A. R. P.

## XIX.—CLEANING AND FINISHING

(Continued from pp. 393-396.)

**Carbon Tetrachloride as a Technical Degreaser.** Max Richter (*Chem. Zeit.*, 1933, 57, 545).—If carbon tetrachloride is quite dry, its vapour has very little corrosive action on most metals, and is suitable for degreasing prior to plating. Since it is cheap and non-inflammable, it forms a good substitute for trichlorethylene. To prevent the action of moisture, anhydrous calcium chloride should be placed in the heating vessel with the tetrachloride.—A. R. P.

**Researches on Chlorate Colouring Baths.** H. Krause (*Mitt. Forschungsinst. Edelmetalle*, 1933, 7, 17-24).—The colours produced on copper and on various brasses and bronzes by pickling for different periods in chlorate baths containing various addition agents are tabulated and the mechanism of the reactions involved is discussed.—A. R. P.

**Surface Treatment of Light Metals.** René Leonhardt (*Oberflächentechnik*, 1933, 10, 106-107).—Polishing and plating processes are briefly described.

—A. R. P.

**On Researches with Oils Used in Polishing [Metals].** H. Stäger (*Schweiz. Verband für die Materialprüfungen der Technik, Diskussionsber.*, No. 24, 1932, 5-17).—The characteristics of good oils for grinding and polishing metals, especially steels and cast iron are discussed.—A. R. P.

**The Size Control of Abrasive Powders.** Henry R. Power (*Metal Cleaning and Finishing*, 1933, 5, 40-41).—A review.—S. G.

## XX.—JOINING

(Continued from pp. 396-405.)

**Modern Riveting Practice in Foreign Aero Construction.** Wilhelm Pleines (*Z. Flug. u. Motor.*, 1933, 24, (3), 65-75).—Cases of failure in adjacent and apparently similar Duralumin rivets are attributed to lack of standardization in working, heat-treatment, and storage. American practice with regard to these is reviewed. Emphasis is laid on the necessity for close temperature control and efficient heat distribution during heat-treatment, on quick and effective quenching, and on arrangements for cold storage: quenching baskets and storage containers are illustrated, and the results of investigations on these points carried out by a firm of aircraft constructors are summarized. English work is reviewed on the stability and limitations of riveted joints, standardization of size, shape, and position of rivets, strength of lapped joints, and the De Bergue process is described and illustrated. A bibliography is appended.—P. M. C. R.

**109° Below Zero [Suppressing Ageing of Duralumin Rivets].** Charles O. Herb (*Machinery (N. Y.)*, 1933, 39, 305-309; and *Machinery (Lond.)*, 1933, 41, 757-760).—Includes a description of dry ice (solid carbon dioxide) refrigerators suitable for maintaining heat-treated aluminium alloy rivets at  $-20^{\circ}$  F. ( $-29^{\circ}$  C.) to prevent age-hardening before use.—J. C. C.

**Soft Solders and Fluxes.** O. F. Hudson (*Met. Ind. (Lond.)*, 1933, 42, 468-470, 494-496).—Abstract of a paper read before the Sheffield Local Section of the Institute of Metals. Solders are classified as soft (low melting point alloys) and hard (silver and brazing solders). The principles of soldering and the action of fluxes are described. Zinc chloride is generally used as a flux, but the addition of ammonium chloride in eutectic proportions gives better results. Soft solders consist primarily of alloys of lead, tin, and antimony. The chemical composition, grades, physical properties, and applications of British Standard soft solders are given, and the characteristics of soft solders other than the lead-tin alloys are briefly described.—J. H. W.

**New Type Flux [Flosol Cream].** Anon. (*Chem. and Met. Eng.*, 1933, 40, 154).—A very brief note. Soldering of most of the commonly used metals except aluminium and its alloys is said to be readily accomplished by the use of a new flux named "Flosol Cream." This is applicable where the prevention of rust is of vital importance. A thin film of flux is applied like paint and neither runs nor spreads.—F. J.

**Non-Corrosive Organic Flux for Soldering.** Tsuneo Suzuki and Kazuhiko Oma (*Rikugaku Kenkyū-jo Iho (Bull. Inst. Phys. Chem. Res. Tokyo)*, 1932, 11, 1060-1061; and English abstract, *Sci. Papers Inst. Phys. Chem. Res. Tokyo*, 1932, 19, (380-382); *C. Abs.*, 1933, 27, 55).—A certain derivative of  $C_6H_4(CO)_2O$ , such as  $C_6H_4(CONH_2)CO_2H$ ,  $C_6H_4(CO_2H)CO_2NH_2$ ,  $C_6H_4(CO_2NH_2)_2$  in 1-5% aqueous solution containing 30%  $CH_2OH\cdot CHOH\cdot CH_2OH$ , applied as the soldering flux, dissolves oxides from the metallic surface, and soldering can easily be effected. On continued heating, the excess of the flux is converted into  $C_6H_4(CO)_2NH$  and volatilizes at  $238^{\circ}$  C., leaving none of the corrosive compound, but only a trace of metallic oxides (Japanese Patent No. 92,672). Although the  $NH_4$  salts of  $(CH_2CO_2H)_2$  may also be used, the irritant fumes of volatilized succinimide exclude them from practical use.

—S. G.

**Soldering Glass to Metal.** J. F. Kesper (*Diamant*, 1932, 54, 256; *Ceram. Abs.*, 1933, 12, 56).—A brief description is given of the method followed in soldering glass.—S. G.

**Electric Welding.** M. Mathieu (*Bull. Soc. Franç. Élect.*, 1931, 1, 810-845; *Sci. Abs.*, 1932, [B], 35, 23).—Describes weldings by d.c., 1-phase, and 2-phase, and by various methods, including resistance, spark, arc, and hydrogen-arc.



Each method is discussed in detail. Resistance welding: 1-phase, l.f. is preferable, but the use of h.f. and condenser discharges is also mentioned. Spark welding: whereas the former method needs a l.t., high-current supply, spark-welding needs a higher voltage and lower current; on the ends to be welded attaining a suitable temperature, pressure is applied to force them together. Arc welding with a carbon electrode is limited by surface oxidation, and welding by arc in an atmosphere of hydrogen is the method next detailed; a tungsten electrode is usual with this process. Then follow the details of the design of machines for different welding processes, including desirable characteristics, size, rating, automatic regulation, conditions for stability, &c.

—S. G.

**Modern Welding Machines and their Applications.** P. Neumayer (*Bull. Soc. Franç. Elect.*, 1931, 1, 846-855; *Sci. Abs.*, 1932, [B], 35, 23).—A consideration of generators for resistance and arc welding. Both d.c. and 1-phase generators are dealt with, the former being predominant in the paper, the generator usually being compounded and having both field control for voltage and series resistance for current. General considerations are followed by desirable characteristics required, and, finally, by several applications of welded joints including the now common fabricated construction.—S. G.

## XXI.—INDUSTRIAL USES AND APPLICATIONS

(Continued from pp. 459-469.)

**Aluminium as a Cause of Cancer.** Heinrich Zellner (*Chem.-Zeit.*, 1933, 57, 193-194).—It is maintained that alumina in food does not produce cancer and that the small quantity derived from aluminium cooking utensils is far less than naturally occurs in many foods.—A. R. P.

**Aluminium as a Cause of Cancer.** O. Baumann. Heinrich Zellner (*Chem.-Zeit.*, 1933, 57, 424-425, 496).—A discussion of Z.'s article (cf. preceding abstract) and a reply. B. considers that alumina is non-toxic, but suggests that cooking food in aluminium vessels may produce toxic substances, since aluminium is a powerful reducing agent and readily reduces many organic compounds, thus it decolorizes yolk of egg and discolours wine. No data have yet been published of work done on these lines. Z. maintains that aluminium salts are non-toxic.—A. R. P.

**Aluminium as a Cause of Cancer.** — Kornick (*Chem.-Zeit.*, 1933, 57, 576).—A reply to Baumann (preceding abstract). Iron is much more active in reducing organic matter than is aluminium, and readily discolours acid foods, hence the contention that cancer has increased since aluminium vessels have come into common use cannot be upheld on this account. Granted that ironware is usually enamelled, a great deal of use is made of it after the enamel is chipped to expose the metal.—A. R. P.

**Possible Uses of Aluminium.** Anon. (*Aluminium*, 1933, 15, (8), 1-3).—The sphere of usefulness of aluminium in domestic appliances, as a wrapping material in the form of foil, in the chemical and foodstuff industries, and in electrical work, is reviewed.—A. R. P.

**Aluminium Dairy Utensils.** Anon. (*Milk Trade Gazette*, 1933, Jan. 7; *Aluminium Broadcast*, 1933, 3, (42), 10-12).—J. C. C.

**Use of Aluminium in Dairy Equipment.** H. A. Trebler (*Aluminium Broadcast*, 1933, 4, (6), 2-8).—Extracts, with full bibliography, from a paper to the International Association of Milk Dealers. The non-toxicity, absence of effect on flavour, and nutritional value, and low solubility of aluminium make it the best material for handling milk. Necessary precautions include avoiding contact with other metals, adding silicate to cleaners and chromate to brines, and using rubber gaskets to connections.—J. C. C.

**Aluminium Booms and Buckets on Mississippi Levees.** Douglas B. Hobbs (*Engineering News-Record*, 1933, 110, 192-194).—A detailed comparison is made between a composite 175-ft. aluminium-steel dragline excavator boom and a 150-ft. all-steel boom. The weight of the aluminium boom is 37.0% less, the overturning moment 9% less, the swing inertias with full and empty buckets 8.6% greater and 4.1% less, respectively, and the speed of excavation 10-30% greater. Further, by substituting aluminium-steel for all steel construction, the weight of 2 cubic yard buckets is decreased by 49-54.7% and the payload increased by 1500 lb.—J. C. C.

**Electrical Condensers Using Aluminium.** G. Gualtierotti (*Ingegneria moderna*, 1932, 10, 356-365).—A long, detailed study, illustrated by a number of diagrams, on the effect of alloying elements in aluminium on the impedance, capacity, resistance, and probable life of condensers of the various commercial types.—G. G.

**Aluminium Cylinder Heads Urged as Way to Better Design.** F. F. Kishline (*J. Soc. Automotive Eng.*, 1933, 32, 121-123).—Actual gains in performance have been registered by using aluminium instead of iron for cylinder heads in internal-combustion heads. The reason for the improvement is somewhat obscure.—W. P. R.

**New Road Vehicles and Coachbuilding in Light Metals.** M. Koenig (*Allègement dans les Transports*, 1933, (5-6), 58-64).—A brief review is given of modern practice in the design of motor-coach bodies incorporating pure aluminium and its alloys Anticorodal and Aluman. Bodies constructed of light metals are stated to be lighter than similar bodies made with high-strength steels.—R. B. D.

**The Savings in Weight being Effected in Railway Rolling Stock by the Use of Aluminium and its Alloys in Place of Steel.** Anon. (*Allègement dans les Transports*, 1933, (5-6), 71).—A table gives comparative figures obtained in the U.S.A. for the weights of various parts of motor and trailer rail coaches and of tramway cars in steel and also in aluminium. The reduction in weight varies from 29.7 to 31%.—R. B. D.

**Aluminium Plymax.** Anon. (*Aluminium Broadcast*, 1933, 4, (8), 14-15).—"Plymax" consists of plywood to which thin sheet galvanized steel or aluminium is cemented on one or both sides. It is used for vehicle bodies and panelling generally.—J. C. C.

**Thermal Insulation with Aluminium Foil.** Anon. (*Metallurgia*, 1933, 7, 190).—The efficiency of various types of aluminium foil air-cell insulation, which depends on a combination of the low thermal conductivity of air with the low emissivity or radiating power of bright aluminium foil in a structure designed to minimize air convection currents, is considered. These include the plain air-cell type, the type with corrugated separators between the sheets of aluminium foil, and the type containing crumpled aluminium foil. The first type is the most efficient, due to low air convections currents, such currents being more pronounced in the other two, particularly the latter.—J. W. D.

**Aluminium Foils and Plates for Photomechanical Impressions.** Karl Hansen (*Aluminium*, 1933, 15, (1), 4-5).—The lightly sand-blasted metal is coated in a yellow light with an albumen solution containing ammonium bichromate and a little ammonia. The photographic negative is then fixed firmly to the dried coating and the whole exposed to bright sunlight or to the light of an arc or powerful half-watt lamp. The negative is removed and the film covered with a thin layer of oil-paint (so-called developing paint), dried in a current of cold air, and allowed to soak in a cold-water bath for some minutes. Developing is effected by gentle rubbing with a pad of cotton wool under water. After touching up and drying, the plate is etched with a thick

rubber solution containing 4 drops of phosphoric acid in 10 c.c., and is then ready for use in printing.—A. R. P.

**Anaconda Hollow Copper Conductors.** T. J. Little (*International Conference on Large H.T. Systems, Paris, 1931*, 1-18; *Sci. Abs.*, 1932, [B], 35, 183).—An account is given of the uses, design, and test results of the Anaconda hollow copper conductor. The purpose of the conductor is to reduce loss due to corona and skin effect. It consists of a flat-rolled soft copper I-beam which is spiralled on its longitudinal axis in helical fashion to form the core, and of a layer of hard-drawn copper wires which is then cabled around this in a direction opposite to the lay of the core. Details are given of the physical properties and tests of corona loss. Anaconda conductor is stated to be immune from vibrational fatigue. The accessories used are described, and an account is given of some installations where Anaconda conductor is employed.—S. G.

**Copper Roof and Wall Construction.** Anon. (*Eng. and Min. J.*, 1933, 134, 95).—A note on possible applications of laminate metal using electrodeposited copper. The copper sheets have the burnished appearance of rolled copper in weights varying from 1 oz. to 8 oz. per ft.<sup>2</sup>, in widths of 30 to 50 in. and in unlimited lengths. The most promising application of the sheets is for built-up metal roofing, with asphalt and also with a backing of heavy cotton fabric impregnated with asphalt bonded to the copper by a coating of pitch compound.—R. Gr.

**Copper-Nickel Tubes; Their Advantages for Steam Condensers.** Robert Worthington (*Metal Progress*, 1933, 24, (1), 20-24).—The greater cost of installing copper-nickel condenser tubing (20% nickel) in place of Admiralty brass is shown by the results of actual working to be more than justified. The superior performance of the copper-nickel is attributed to the compact and resistant nature of the protective film developed on its surface; this remains unbroken under the exacting conditions of modern turbine practice, which often cause rapid breakdown in Admiralty tubing. The general mechanism of corrosion is discussed, and the influence on it of the high velocities and turbulent flow characterizing modern conditions is considered.—P. M. C. R.

**Lead-Boring Beetles.** Henry P. Ehrlinger (*Eng. and Min. J.*, 1933, 134, 122).—A letter to the Editor, containing a note on and illustration of the *Monochamus Titillaria*, commonly known as the lead-boring beetle. Heating the infested areas with live steam kills all the larvæ.—R. Gr.

**Elektron in European Omnibus and Lorry Construction.** Anon. (*Z. ges. Giesserei-Praxis: Das Metall*, 1933, 54, 180-184, 202-204).—The applications of Elektron to the manufacture of various parts of heavy transport vehicles is described.—J. H. W.

**Molybdenum. Its Mining, Milling, and Uses.** Alan Kissock (*Min. and Met.*, 1933, 14, 181-182, 189).—A review.—A. R. P.

**Pure Nickel for the Chemical Industry.** Anon. (*Apparatebau*, 1933, 45, 49-52).—An illustrated article showing the high serviceability of nickel as construction material in numerous branches of the chemical industry. Qualitative data are given on the corrosion-resistance against various chemical agents.—M. H.

**Nickel Clad Steel Plate Work.** W. G. Humpton, F. P. Huston, and R. J. McKay (*Japan Nickel Rev.*, 1933, 1, 168-176).—[In English and Japanese.] Light-gauge highly-finished products of nickel and steel bonded and rolled in intimate contact have been known for many years. The newer products, however, are of much heavier thicknesses, with the nickel about 10% of the whole, intended for more massive structures. The methods which have been adopted in the manufacture of the modern material, the precautions it is necessary to take, and the procedure in forming the plate into shapes are

described and discussed. Pure nickel rivets have been found best hitherto for preserving the essential continuity of the nickel surface. All possibility of steel being exposed at joints is prevented by careful caulking with a tool slightly more rounded than is normally used. By adopting appropriate methods there is no loss of strength by using nickel-clad steel, instead of all steel, structures.—W. A. C. N.

**Nickel and Nickel Alloys for Oil-Refinery Equipment.** O. B. J. Fraser (*Refiner Natural Gasoline Manuf.*, 1933, 12, 162-173; *C. Abs.*, 1933, 27, 3433).—Compositions, properties, and corrosion data are given for several alloys.—S. G.

**Monel Metal in Pickling Installations.** A. Jaeschke (*Glashütte*, 1933, 63, 132-133; *C. Abs.*, 1933, 27, 2656).—Data are given on the manufacture of Monel metal. The two main properties which make it so suitable for use in pickling installations are (1) its high strength and resistance to the corrosive action of acids used in pickling, and (2) the ease with which it can be worked. It is resistant to almost all acid solutions except nitric and sulphuric acids. —S. G.

**Platinum in 1932.** Charles Engelhard (*Met. Ind. (N. Y.)*, 1933, 31, 134).—A brief review.—A. R. P.

**The March of Platinum in Industry.** Edmund M. Wise (*Metal Progress*, 1933, 23, (4), 36-40).—A survey of the progressive adoption of platinum as a catalyst, as thermo-couple wire, in electrical contacts, in thermionic amplifiers, in ornamental work, and as laboratory ware. Some uses of the associated metals are also given.—P. M. C. R.

**Silver and Its Uses in Chemical Plant.** Anon. (*Met. Ind. (Lond.)*, 1933, 42, 345-346).—The physical properties and chemical behaviour of silver are briefly reviewed, and its application to the manufacture of acetic acid and other chemical plant and the use of "double" (pure silver sheet rolled on to copper or other base metal) are described.—J. H. W.

**Spinnerets of Tantalum.** Anon. (*Siemens Z.*, 1933, 13, 132).—Tantalum must be regarded as the most suitable material for spinnerets used in the manufacture of artificial silk.—M. H.

**On the Application of the Hard Metal Widia in Technology.** C. Agte (*Forschungen u. Fortschritte*, 1933, 9, 42-43).—A short review.—J. W.

**Proposed Revised Tentative Specifications for Zinc-Base Alloy Die-Castings.** — (*Amer. Soc. Test. Mat. Preprint*, 1933, 8-11).—Appendix to Report of Committee B-6 on Die-Cast Metals and Alloys (see *J.*, this volume, p. 522). The alloys are to conform to the following composition—

	Alloy XXI.	Alloy XXIII.
Copper, % . . . . .	2.5-3.5	0.10 (max.)
Aluminium, % . . . . .	3.5-4.5	3.5-4.5
Magnesium, % . . . . .	0.02-0.10	0.03-0.08
Iron (max.), % . . . . .	0.100	0.100
Lead (max.), % . . . . .	0.007	0.007
Cadmium (max.), % . . . . .	0.005	0.005
Tin (max.), % . . . . .	0.005	0.005
Zinc, % . . . . .	remainder	remainder

The average expansion after exposure to water vapour at 95° C. for 10 days shall not exceed 0.0025 in. per in. for alloy XXI and 0.0010 for alloy XXIII. Tension and impact values are not necessarily determining factors in the acceptance of these castings, but when specified should conform to the following limits—

	Average.		Individual.	
	XXI.	XXIII.	XXI.	XXIII.
Tensile strength (min.), lb./in. <sup>2</sup>	44,000	35,000	35,000	30,000
Elongation (min.), % on 2 in.	2.0	3.0	0.5	2.0
Charpy impact (min.), ft.-lb.	6.0	12.0	4.0	8.0
After exposure to water vapour at 95° C. for 10 days—				
Tensile strength (min.), lb./in. <sup>2</sup>	30,000	30,000	...	...
Elongation (min.), % on 2 in.	0.5	1.5	...	...
Charpy impact (min.), ft.-lb.	0.75	14.0	...	...

The dimensions of the test-pieces are given in two illustrations.

—W. A. C. N.

**Vibrations in Free Transmission Lines and Their Damping by Resonance Vibrators.** Fritz Puritz (*Metallwirtschaft*, 1933, 12, 35-38).—The vibrations of the masts and lines of overhead electrical transmission systems by the wind have been investigated, and the construction and testing of a damping device by the aid of which it is possible to prevent these vibrations from reaching the danger limit are described.—v. G.

**Development of Underground H.T. Cables.** J. Delon (*Congrès internat. d'Élect., Paris, Sect. 7, Rapport No. 9*, 1932, 1-16; *Sci. Abs.*, 1932, [B], 35, 711).—A brief historical summary is given of the improvements in underground high-tension cable construction since 1881, showing the gradual increase of operating voltage up to the proposed 220 kv. A section of the paper is devoted to oil-filled cables, and others to lead coverings, methods of resisting corrosion, and protective devices.—S. G.

**Manufacture of Cable and Overhead Equipment.** A. L. Sanders (*Trans. S. African Inst. Elect. Eng.*, 1932, 23, 191-202, discussion, 202-204; *erratum*, 273; *Sci. Abs.*, 1932, [B], 35, 710).—The paper deals with (1) the history of the development of insulated cables, together with a supplement giving a short history of the manufacture of paper-insulated cables; (2) the development of telephone cables; (3) materials used in cable manufacture; (4) copper used for conductors of electric cables; (5) wire-drawing; (6) stranding the conductors; (7) paper used for insulation; (8) insulating and assembly of the cores; (9) drying; (10) impregnating; (11) lead covering; (12) routine testing; (13) armouring and finishing; and the Grid system.—S. G.

**Metallurgy of Refining Equipment.** R. L. Duff (*Refiner Natural Gasoline Manuf.*, 1933, 12, 110-114; *C. Abs.*, 1933, 27, 3426).—A discussion of the selection and applicability of alloys and metals for all important refinery equipment.—S. G.

## XXII.—MISCELLANEOUS

(Continued from pp. 469-476.)

**Metals in the Service of Human Life and Industry.** (Sir) Harold Carpenter (*British Science Guild. Research and Development Lecture*, 1933, 1-39; and (abstract) *Met. Ind. (Lond.)*, 1933, 42, 546).—Metals are the products of the physical universe which have contributed most to the material wants of humanity. In a great variety of ways metallic materials enter into the activities of life, and it is almost impossible to trace all the ramifications in which they are involved. In a wide sense industry means all the purposeful productive activities of mankind, and these include agriculture, fishing,

mining, and metallurgy. In both material and mental directions metallurgy has great achievements to its credit. The metals used by engineers in the earliest days had already long been known. Subsequently, however, reciprocal developments in the two branches occurred. The earth's crust, possibly originally molten, has suffered much differentiation by geological, physical, and chemical processes, with the result that the various metals, mostly in the form of compounds, are segregated in particular districts. The industrial history of mankind may be conveniently divided into two major epochs, a Stone Age and a Metal Age, between which was a transitional period in which native metals were used as stones. The outstanding discovery of our present civilization was the smelting of a metal from a stone. The art of the metal-smith was one of the earliest to be developed, but the real expansion came when it was realized that metals could be smelted, and the products therefrom fashioned into useful articles for every-day use. The fascinating story of the subsequent production of iron and steel and the common non-ferrous metals is unfolded by C. In the next section the casting, mechanical, chemical, and physical properties of metals and alloys are considered. The last section is devoted to a consideration of the effects of science on metallurgy and the metal arts. The definite urge to progress and research is of comparatively recent date, and some of the outstanding examples of the results of such investigation are quoted—the development of aluminium, magnesium, and beryllium, the introduction of high-speed tool steels and of carbide cutting alloys, the advance of stainless steel, and the world-wide use of manganese steel.—W. A. C. N.

**Ancient Egyptian Antimony Plating on Copper Objects. A Rediscovered Ancient Egyptian Secret.** Colin G. Fink and Arthur H. Kopp (*Metropolitan Museum Studies* 4, 1933, 162-167; *C. Abn.*, 1933, 37, 2628).—A copper ewer and basin of the Fifth or Sixth Dynasty were found to be plated with antimony. After a careful analysis and many tests it was possible to obtain bright antimony plates by the electrolytic displacement method with only such chemicals as were available 5000 years ago.—S. G.

**The Antimony Industry During the Last Twenty Years.** Kuo Ho (*Science (China)*, 1933, 22, 31-36; *C. Abn.*, 1933, 37, 2615).—A historical review, with figures for production and quality of product.—S. G.

**International Foundry Congress.** *Ann. (Metallurgie) (Suppl. to Engineer)*, 1932, 8, 181-182.—A brief account of the papers presented at the meeting in Paris, September 1932.—E. G.

**Electrical Precipitation.** M. Shibusawa and S. Fukuda (*Compt. Rend. Acad. Sci. Paris, Sect. 12, Report No. 1832*, 1932, 1-7; *Sci. Abn.*, 1932, [5], 15, 712).—The authors state that their previous research has shown that the rapidity with which charged particles are removed by electrical precipitation is proportional to the actual charge carried by the particle and to the intensity of the field through which the charged particles are carried, or are in movement. The measurement of the amount or value of the charge which can be carried by a particle is therefore very important in its bearing on the efficiency of electrical precipitation, and the present paper gives the results of their investigations on this subject. The following conditions have been arrived at as favouring rapid separation of the dust particles: (1) small diameter of the collecting and of the discharge electrodes; (2) high e.m.f. of the discharge; (3) high temperature of the gases; and (4) low density of the particles in the gas which is being cleaned.—S. G.

**Report of Committee E-3 (of A.S.T.M.) on Research.** H. F. Moore and C. L. Warwick (*Proc. Amer. Soc. Test. Mat.*, 1932, 32, (1), 319-321).—The researches now being undertaken include the following: the effect of tin and arsenic on high-speed tool steels; the yield point of structural steel; fatigue of metals; effect of phosphorus and sulphur on steel; the effect of temperature on the

properties of metals; mineral aggregates; corrosion of electroplated coatings; tin and lead-base die-casting alloys; light metals and alloys.—W. A. C. N.

**High-Temperature Research.** Anon. (*Metallurgist* (Suppl. to *Engineer*), 1932, 3, 49-50).—Some remarks concerning the new research programme of the American Society for Testing Materials and the questions of overlapping and international co-ordination.—R. G.

**Research and the American Society for Testing Materials.** F. O. Clements (*Proc. Amer. Soc. Test. Mat.*, 1932, 32, (1), 31-39).—Presidential address.—S. G.

**Scope of Research Management.** C. E. K. Mees (*Indust. and Eng. Chem.*, 1932, 24, 65-66). **Logical Divisions of a Research Organization.** Francis C. Frary (*ibid.*, 1932, 24, 67-68). **Principles of Research Laboratory Management.** G. W. Thompson (*ibid.*, 1932, 24, 68-71). **Co-Ordination of Laboratory and Plant Effort.** C. M. A. Stine (*ibid.*, 1932, 24, 191-193). **Preparatory Stage of Research.** M. L. Crossley (*ibid.*, 1932, 24, 193-194). **Functions of a Laboratory Organization.** Robert B. Williams (*ibid.*, 1932, 24, 194-198). **Direction of Investigation in the Experimental Stage.** H. L. Trumbull (*ibid.*, 1932, 24, 199-202). A series of articles on "Management of Research" which considers the functions of laboratory organization and the co-ordination of laboratory and plant effort.—F. J.

**Industrial Research as a Profitable Business.** Anon. (*Metal Progress*, 1932, 22, (2), 41-45).—An account of the research organization of the General Motors Corporation, Detroit, U.S.A., with a survey of the scope and activities of the various sections.—P. M. C. R.

**Co-operative Chemical Engineering Research in the University.** D. B. Keyes (*Indust. and Eng. Chem.*, 1932, 24, 947-949).—Experience has clearly shown that between industry and the university the only co-operative problems which are mutually satisfactory are those that the university research workers are well adapted to undertake and those that are of such a nature that, on publication of results, will widely attract interest and respect. The necessity for strengthening the teaching staff by adding well-trained experienced research men who have shown research ability in industry is pointed out. Advantages of co-operative research, and examples of success attending such co-operation are discussed. Co-operative investigations, financed by industries or groups of industries and carried out in universities, under proper management, are bound to succeed.—F. J.

**Information Service in Industrial Research Laboratories.** Julian F. Smith and Irene F. Smith (*Indust. and Eng. Chem.*, 1932, 24, 949-953).—The research director of to-day cannot stop at providing library facilities in the way of ample bookshelves and patent files. He must arrange for the information to be distributed to the laboratory's staff at minimum cost. The functions of such information service and the qualifications of the person in charge thereof are discussed. Its fundamental principles, cost and performance, measures of performance, current literature bulletins, research laboratory records, correlation of separate units, searches made by chemists, service in small laboratories, and the application of fundamental principles are also dealt with.—F. J.

**A Banker's Viewpoint of Industrial Research.** Broderick Haskell, Jr. (*Indust. and Eng. Chem.*, 1932, 24, 953-955).—No more significant tribute to research can be made than to compare a list of industrial common stocks measured by the frequency with which they appear in the portfolios of investment trusts with a list of companies measured by their activity in industrial research. The order of names on each list is almost identical. For research in industry to be of sound commercial value and beyond the category of rank speculation, it must have as its foundation a vast accumulation of diversified experience, it must be served by large resources and trained judgment, and it must have opportunity for great latitude. The financing of research, publicity in research, and research at the present time are dis-

coussed. Industrial research is regarded as one of the strongest factors making for recovery from the present depression.—F. J.

**Chemical Research in the Depression.** Maurice Holland and W. Spraragen (*Indust. and Eng. Chem.*, 1932, 24, 956-960).—The data provided by a survey recently made by the [U.S.] National Research Council through its Division of Engineering and Industrial Research are discussed. They show that even in times of adverse business conditions the leaders of chemical industry should turn to research as a useful tool in maintaining their profits and reducing losses to a minimum.—F. J.

**Stabilized Research—A National Research.** L. V. Redman (*Indust. and Eng. Chem.*, 1932, 24, 1198-1199).—Presidential Address to the American Chemical Society.—F. J.

**Report of Committee E-8 [of A.S.T.M.] on Nomenclature and Definitions.** Cloyd M. Chapman and R. E. Hess (*Proc. Amer. Soc. Test. Mat.*, 1932, 32, (1), 515-518).—A summary of the year's work and a glossary of terms and certain standard definitions.—W. A. C. N.

**Organization of Scientific Research in France.** Albert Ranc (*Chim. et Ind.*, 1932, Special No. (March), 862-866).—S. G.

**Organization of Scientific Research in Germany.** Jean Fleury-Bernheim (*Chim. et Ind.*, 1932, Special No. (March), 867-871).—S. G.

**New Tools for High-Temperature Research.** Robert B. Sosman (*Indust. and Eng. Chem.*, 1931, 23, 1369-1374).—Uniformity of temperature is most complete in a liquid which is stirred, and this condition is approximated in some of the newer fuel-fired furnaces in which the gases are in a state of turbulent flow. It is imitated in a new type of electric-resistance furnace, in which the air is artificially circulated by means of a fan. In electric-resistance furnaces in general most of the improvements have been in the material of the resistor rather than in the design of the furnace. The high-frequency induction method of heating is a new tool capable of producing almost perfect uniformity in a liquid conductor, but not in a solid. The most recently developed source of high-temperature heat is solar energy, which has been concentrated by a focusing mirror and heliostat at Jena, to give results comparable with those obtainable in laboratory furnaces. The thermo-electric pyrometer, assisted by potentiometric indicators and recorders, offers the best method for studying uniformity. The new thermocouple alloys are capable of considerable improvement in homogeneity and reproducibility. Attempts to introduce light-sensitive devices into the optical type of pyrometer have not reached finality. Materials of construction for high-temperature work are not yet sufficiently pure. Better design and improvement in conductivity of refractories have made for more uniformity in research work. The greatest need of research is an institution for the study and improvement of laboratory apparatus and for the manufacture and sale of items too infrequently in demand or too difficult to make to have a dependable market.—F. J.

**Determination of Quality as a Basis for Commodity Standards.** F. W. Reynolds (*Rev. Sci. Instruments*, 1932, 3, 371-377).—An extremely readable article dealing with modern developments of standardization. R. contends that standardization of commodities should be progressively dynamic, not static; it should not minutely circumscribe limits to stifle initiative, but should set up minimum requirements for essential features, leaving non-essentials to individual discretion; it should not try to force something new and untried on industry.—J. S. G. T.

**On Drawing up Specifications.** R. Digby-Smith (*Mech. World*, 1932, 92, 525-526).—Firms doing special work sometimes need products which are not covered by standard specifications, and, since goods ordered to customer's specification are usually priced slightly higher than the equivalent line of standard product, great care should be taken to introduce as few departures



as possible from the standard line. The object of a specification is not to ensure the nearest possible approach to perfection, but rather that the work will be such as to meet all the practical requirements of the user, with sufficient reserve. The outstanding properties of a well-conceived specification are: (1) definitiveness; (2) brevity; (3) clarity; (4) permanence; (5) convenience.

—F. J.

**Standards.** Anon. (*Metallurgist* (Suppt. to *Engineer*), 1932, 8, 113-114).—A discussion of suggestions that British standards of design and construction are unduly high, and of the connection with standard specifications for materials.—R. G.

**Report of Committee E-10 [of A.S.T.M.] on Standards.** T. R. Lawson and C. L. Warwick (*Proc. Amer. Soc. Test. Mat.*, 1932, 32, (I), 522-528).—A general summary of the work undertaken by the various Committees during the previous year, and of specifications issued as the result of their deliberations.—W. A. C. N.

**The Role of the Trade Association in Standardization.** Paul Gough Agnew (*Amer. Standards Assoc. Bull.*, 1930, (50), 3-6).—S. G.

**Bibliography on Standardization.** [Anne L. Baden] (*U.S. Bur. Stand. Misc. Publ. No. 136*, 1932, 1-18).—Supplementary to the lists printed in the Standards Yearbook for the years 1928, 1929, 1930, and 1931.—S. G.

**The Effect of Standardization on Engineering Progress.** C. Le Maistre (*J. Roy. Soc. Arts*, 1931, 79, 327-342; discussion, 342-351; and (abstract) *Mech. World*, 1931, 89, 250-251, 268-270).—F. J.

**Standardization.** L. A. Legros (*Proc. Inst. Automobile Eng.*, 1930-31, 25, 344-365; discussion 366-369; and (abstract) *Mech. World*, 1931, 89, 300-301).—F. J.

**The Calculation of Errors by the Method of Least Squares.** Raymond T. Birge (*Phys. Rev.*, 1932, [ii], 40, 207-227).—The method of least squares is developed with special reference to the reliability or probable error of quantities calculated from experimental data by the method of least squares, and the reliability of the probable errors thus calculated.—W. H.-R.

**Machinery Breakdowns Caused by Cracks.** Edward Ingham (*Colliery Engineering*, 1931, 8, 310-311).—The part played by faulty alignment in causing over-stress and subsequent failure is emphasized. Other causes are (1) pounding and knocking due to excessive wear, (2) faulty design, (3) vibration. Methods of inspection are described.—P. M. C. R.

**General, Plant, and Machinery.** R. E. V. Hampson and J. N. Vowler (*Ann. Rep. Prog. Applied Chem.*, 1931, 16, 5-24).—A summary of progress during 1931, with reference to various subjects of non-ferrous interest discussed at the 1931 meeting of the New International Association for Testing Materials. Other papers noted refer to heat transfer, lubrication, the use of non-ferrous metals for pressure vessels, the strength of welded joints, and various instruments.—H. F. G.

**The Handling of Materials in a Mass-Production Factory.** W. L. Beeby (*Proc. Inst. Mech. Eng.*, 1931, 121, 559-571).—Describes briefly methods for conveying materials to and from or between machines in a mass-production factory. These include jack-lift or elevating trucks, different types of overhead runway, roller tracks, and moving belt conveyors. B. emphasizes the importance of designing the handling scheme so that material is handled as seldom as possible, for the shortest possible distance, with a continual flow which avoids accumulating finished material between operations.—W. H.-R.

**Adapting the Conveyor to the Needs of Industry.** Anon. (*Canad. Mach.*, 1931, 42, 160-164).—Types of bearing for roller conveyors of varying capacity are discussed. Spiral conveyors are much used for small work, but even then special support is required. Belt conveyors, necessitating a straight run, require special connecting sections where the system branches. Types of each

of the above are illustrated. An ingenious adaptation of the roller conveyor is used in the assembly and enamelling of refrigerator cabinets; here a turntable is included in the conveyor system.—P. M. C. R.

**Modern Mechanical Handling Appliances.** Maurice Pelou (*Science et Industrie*, 1932, 16, 31-41).—Mechanical handling plant is considered by P. under two headings—for intermittent and for continuous delivery. The first covers the conveying of loads by isolated elements capable of independent handling and of reversed direction, where the drive may therefore be either continuous or interrupted: this includes overhead, railway and road conveyors. The second includes continuously operated conveyors arranged in series, working in a uniform manner and in the same direction throughout the system. These are further classified according to the presence or absence of a traction unit (cable, runner, chain, &c.). Characteristic types, with their advantages and limitations, are discussed and illustrated.—P. M. C. R.

**Industrial Lighting.** S. Anderson (*Machinery (Lond.)*, 1930, 35, 449-450).—Describes the advantages of a suitable system of lighting in factories and workshops and gives some data for the increase of production resulting from the adoption of a modern system.—H. F. G.

**The Lighting of Factories and Large Buildings.** E. W. Smith (*Gas World (Indust. Gas Suppl.)*, 1931, 3, (9), 10-17).—Read before the International Illumination Congress, Buxton, 1931. Applications of gas for purposes of factory lighting are discussed and illustrated.—J. S. G. T.

**Temperature-Sensitive Compounds.** Herbert Chase (*Chem. and Met. Eng.*, 1932, 35, 345).—A list is given of compounds which change colour on heating, the precise nature of the change being given in each case. One of the applications of such compounds is in the form of pigments for detecting temperature changes in bearings and other machinery parts.—F. J.

**Mineral Oils.** Alfred W. Nash and A. R. Bowen (*Ann. Rep. Prog. App. Chem.*, 1932, 17, 83-113).—A summary, with full references, is given of papers published during 1932 concerning, *inter alia*, lubrication and lubricating oils and greases; the adherence of lubricants to metals, *i.e.*, the rates at which various oils flow off surfaces of copper, aluminium, iron, and steel; the behaviour of non-acid oils in contact with different metals; and insulating oils, fuel oils, and bituminous paints.—H. F. G.

### XXIII.—BIBLIOGRAPHY

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

(Continued from p. 477.)

- \***Aluminium.** *A Select Annotated Bibliography on the Hygienic Aspects of Aluminium and Aluminium Utensils.* (Mellon Institute of Industrial Research. Bibliographic Series. Bulletin No. 3.) With a Preface by Edward R. Weidlein and an Introduction by George D. Beal. Med. Svo. Pp. xi + 80. 1933. Pittsburgh, Pa.: Mellon Institute of Industrial Research.
- American Society for Testing Materials.** *Specifications and Methods of Test for Refractory Materials and Manual for Interpretation of Refractory Test Data.* Pp. 93. 1932. Philadelphia, Pa.: The Society, 1315 Spruce St. (50 cents.)
- Atack, F. W., and others.** Edited by. *Chemists' Year-Book*, 1933. Pp. 224. 1933. London: Sherratt and Hughes. (21s. net.)
- \***Bader, Ernst W. und Holstein, Ernst.** *Das Quecksilber: seine Gewinnung, technische Verwendung und Giftwirkung mit eingehender Darstellung der gewerblichen Quecksilbervergiftung nebst Therapie und Prophylaxe.* Med. Svo. Pp. 238, with 21 illustrations. 1933. Berlin: Richard Schoetz, Wilhelmstrasse 10. (Br., M. 12.60; geb., M. 14.80.)

- \***Bastien, Paul.** *Étude des Alliages Magnesium-Aluminium-Cuivres riches en Magnesium.* Préface de Léon Guillet. *Contribution à l'Étude des Propriétés de Fonderie des Métaux et Alliages.* Préface de Albert Portevin. (Publications scientifiques et techniques du Ministère de l'Air. Service des Recherches de l'Aéronautique. No. 20.) 4to. Pp. xiii + 143, with 170 illustrations. 1933. Paris: Gauthier-Villars et Cie. (30 francs.)
- Belasio, Riccardo.** *Nozioni di elettrochimica e di analisi elettrolitica.* Pp. 79. 1932. Roma: A. Sampaolesi.
- \***Bolitho, Hector.** *Alfred Mond, First Lord Melchett.* Med. 8vo. Pp. xi + 392, with frontispiece and 16 illustrations. 1933. London: Martin Secker. (21s. net.)
- \***Bradley, R. S.** *Methods for Servicing Noble Metal Thermocouples.* (American Refractories Institute, Technical Bulletin No. 39.) Med. 8vo. Pp. 6, with 4 illustrations. 1933. Pittsburgh, Pa.: American Refractories Institute.
- British Oxygen Company, Ltd.** *Handbook for Oxy-Acetylene Welders: a Practical Guide to Oxy-Acetylene Welding.* 8vo. Pp. 254. 1933. London: British Oxygen Co., Ltd. (3s. 6d. net.)
- \***Dayton, Russell Wendt.** *An Investigation of Methods of Decarburizing Iron-Nickel-Chromium Alloys.* (Rensselaer Polytechnic Institute Bulletin, Engineering and Science Series, No. 41.) Med. 8vo. Pp. 28, illustrated. 1933. Troy, N.Y.: Rensselaer Polytechnic Institute.
- \***Federation of British Industries.** *Register of British Manufacturers.* Edited by Ernest A. Nash. 1933-1934. Thirteenth Annual Edition. 7 × 9½ in. Pp. xxiv + 516 + 114. 1933. London: Federation of British Industries, 21 Tothill St., S.W.1.
- \***Gmelins Handbuch der anorganischen Chemie.** Achte, völlig neu bearbeitete Auflage. Herausgegeben von der Deutschen Chemischen Gesellschaft. Bearbeitet von R. J. Meyer. System-Nummer 54: *Wolfram.* Sup. Roy. 8vo. Pp. xviii + xi + 397, illustrated. 1933. Berlin: Verlag Chemie G.m.b.H. (R.M. 64; subscription price, R.M. 56.)
- \***Haraldsen, Haakon.** *Die Tensimetrische Analyse der Systeme Gold-Phosphor, Silber-Phosphor, und Kupfer-Phosphor.* (Skrifter utgitt av Det Norske Videnskaps-Akademi i Oslo I. Mat.-Naturv. Klasse. 1932, No. 9.) Roy. 8vo: Pp. 63, with 13 illustrations. 1933. Oslo: I Kommissjon Hos Jacob Dybwad. (Kr. 5.50.)
- \***v. Hevesy, Georg, und Alexander, Ernst.** *Praktikum der chemischen Analyse mit Röntgenstrahlen.* Med. 8vo. Pp. iv + 80, with 17 illustrations. 1933. Leipzig: Akademische Verlagsgesellschaft m.b.H. (M. 4.80.)
- \***Jones, Harry A.** *Metal Work for Grades VII, VIII, and IX.* Demy 8vo. Pp. vi + 112, with numerous illustrations. 1933. Milwaukee, Wis.: Bruce Publishing Co. (80 cents.)
- Loeb, Leonard B., and Adams, Arthur S.** *The Development of Physical Thought.* 8vo. Pp. 648. 1933. New York: John Wiley and Sons, Inc. (\$3.75); London: Chapman and Hall, Ltd. (23s. net.)
- Macchia, Osvaldo, e Pieri, Mario.** *Cromatura industriale. Teoria e pratica. Manuale per il tecnico e per l'operario cromatore.* Pp. viii + 200. 1933. Milano: Ulrico Hoepli. (Lire 10.)
- Marks, Lord, and Wolstenholme, R. A.** *The Patents and Designs Acts.* Pp. 147. London: Sweet and Maxwell, Ltd. (12s. 6d.)
- Martin, A. C.** *The Use of Copper in Plumbing.* Edited by F. Herold. 8vo. Pp. 127. 1933. Manchester: Plumbing Trade Journal.
- \***Perlenfein, Alfred.** *A Chromium Plating Bath with the Fluoride Ion.* (Rensselaer Polytechnic Institute Bulletin, Engineering and Science Series, No. 39.) Med. 8vo. Pp. 36, illustrated. 1933. Troy, N.Y.: Rensselaer Polytechnic Institute.

## XXIV.—BOOK REVIEWS

(Continued from pp. 478—180.)

**Allgemeine und technische Elektrometallurgie.** Von Robert Müller. Med. Svo. Pp. xii + 580. 1932. Wien: Julius Springer. (R.M. 32.50.)

According to general usage, the term "electrometallurgy" covers the application of both electrolytic and electrothermal processes in the service of metallurgy. It should therefore be made clear at the outset that the present volume deals with only one of these sub-divisions—electrolytic processes. There is much to be said for thus restricting the scope of the work, for the principles underlying the two sub-divisions of the subject are essentially different, and considerable confusion of ideas has often arisen through not keeping them separate.

The introductory chapters deal with the general principles of electrolysis, and include an outline of general electrochemistry sufficient for a proper understanding of the electrometallurgical processes described later. A brief account of the modern theory of electrolytic dissociation might have been included with advantage, if only to indicate the general character of developments which have occurred in recent years. On the other hand, the important subject of electrolytic polarization is treated in a very satisfactory manner, and the section devoted to the principles of metallic corrosion forms a useful summary. A section of particular interest is that dealing with the electrolysis of molten alloys, a subject to which the author has largely contributed, but which has not yet found its way into the majority of text-books.

Following this preliminary general discussion which occupies the first 140 pages, is a systematic account of the electrometallurgy of the various metals. Under the heading of each metal there are set out the conditions under which it and its alloys are electrodeposited; its behaviour as an anode; details of the technical electrolytic processes whereby it is extracted and refined, together with production data; an outline of electroplating processes; and a summary of its properties and applications. The metals are considered in groups corresponding with those of the periodic classification, commencing with the very base metals which can be electrodeposited only from molten electrolytes. A general account of the electrolysis of fused salts and of the manufacture and properties of electrodes for this purpose precedes the detailed treatment of the electrometallurgy of the alkali and alkaline-earth metals, aluminium, the rare-earth metals, and metals of the vanadium group. Similarly, the systematic account of the electrolytic extraction and refining of metals such as copper, silver, gold, zinc, cadmium, tin, lead, antimony, bismuth, iron, cobalt, nickel, and members of the platinum group, all of which are electrodeposited from aqueous solutions, is preceded by a general survey of the principal features of such processes, including a good summary of the effects of conditions of operation on the physical character of the metallic deposits. Due reference is made to the electrochemistry of the rarer metals, even in cases where technical applications have not yet ensued.

Whilst not pretending to be an exhaustive treatise, the book succeeds admirably in presenting a thoroughly sound, well ordered, and well authenticated account of the principles and technical operation of all electrolytic processes which have found application in metallurgy. Full references to the scientific, technical and patent literature are supplied, and due attention has been given to recent developments in all parts of the world. The diagrams are clearly drawn and informative, the printing and general make up of the book are excellent, and, apart from a few mis-spellings of the names of foreign authors and journals, the text is satisfactorily free from errors.—H. J. T. ELLINGHAM.

**Gmelins Handbuch der anorganischen Chemie.** Achte völlig neu bearbeitete Auflage. Herausgegeben von der Deutschen Chemischen Gesellschaft. Bearbeitet von R. J. Meyer. System-Nummer 30: Barium. Sup. Roy. Svo. Pp. xvi + 390, with 30 illustrations. 1932. Berlin: Verlag Chemie G.m.b.H. (R.M. 64, subscription price R.M. 56.)

The treatment of the metal barium and its compounds follows the method adopted successfully in the case of other elements. It commences with an account of the history of the element, followed by an account of the minerals of barium and the distribution of these throughout the earth. The methods of obtaining barium compounds from minerals constitutes the next section. Here the methods used on the large scale for the production of the sulphide, oxide, hydroxide, nitrate, chloride, carbonate, silicate, and aluminate from heavy spar are described. The preparation and properties of metallic barium are considered next, in a section of 37 pages. The treatment of the compounds follows, and these are dealt with in the order: compounds with hydrogen, oxygen, and nitrogen; amides, hyponitrites, nitrites, nitrates, fluorides, chlorides, chlorite, hypochlorite, chlorate, bromides, hypobromite, bromate, perbromate, iodides, iodate, periodates, sulphides, sulphites, sulphates, persulphate, thiosulphate, selenide, selenate, telluride, tellurate, boride, borates, carbide, carbonyl, carbonates, percarbonate, thiocarbonate, silicide, silicate, phosphide, phosphates, arsenide, arsenites,

precipitates, solubilities, and combinations. Ferric salts with similar salts of other metals are described, and numerous compounds with organic substances, including many barium salts of organic acids.

The work of compilation has been carried out thoroughly and with discrimination, and a very complete account is given of the knowledge of barium at the moment. The book is a very satisfactory one, and can be recommended without hesitation.—**JAMES F. SHERWIN.**

**Eisen- und Stahlsortenungen. Patentanspruchsgewinn nach Legierungssystemen.** Von A. Grimmer. Pp. vii + 308. 1932. Berlin: Verlag Chemie, G.m.b.H. (R.M. 32.)

This book is an appendix to the section on the metallurgy of iron in the eighth edition of Izod's "Handbuch der anorganischen Chemie"; it contains a classified list of German, English, French, American, Swiss, and Russian patents on iron and steel alloys. The alloys are classified systematically on the system adopted in the Handbuch, and their composition ranges, special properties, and sphere of usefulness are given briefly, together with the name of the patentee, number of the patent, and year of grant. The list includes all patents granted between 1890 and March 1932, and should thus be of considerable reference value to all steel metallurgists.—**A. E. POWELL.**

**Korrosion III. Bericht über die Korrosionstagung 1932 am 17. Oktober 1932 in Berlin.** Veranstalter vom Verein deutscher Ingenieure, Verein deutscher Eisenhüttenleute, Deutsche Gesellschaft für Metallkunde und Verein deutscher Chemiker. Demy Brn. Pp. v + 61, with 35 illustrations. 1932. Berlin: VDA-Verlag, G.m.b.H. (R.M. 4.)

This report of the proceedings of the second German corrosion conference contains only 7 papers, with very brief discussions. Of these, the first deals with the importance of chemical reactions in corrosion and the other 4 with various means of protecting metals—generally iron and steel—from corrosion: the protective devices considered include paints, lacquers and varnishes, enamel, cement and concrete, rubber, ductile iron, and phosphate films. Very little information on the non-ferrous metals is given, and much work on all the subjects discussed is still at times briefly reviewed.—**A. E. POWELL.**

**Sherardizing. A Text-Book for Architects and Engineers.** By G. Petrie and A. C. Mills. Femp. Brn. Pp. iv + 54, with 5 illustrations. 1932. Woburnhampton: Zinc Alloy Rust-Proofing Co., Ltd. (2s. post free.)

This small book is, in the author's opinion, a text-book for architects and engineers. As such, it is very valuable, and should be read by all who have to consider the rust-proofing of finished articles, whether as consumers or manufacturers.

Sherardizing, the invention of an Englishman, has been much neglected in Great Britain in the past, although widely adopted in America. There is no doubt that it has many advantages, giving as it does a surface coating, highly resistant to corrosion despite irregularities in the surface of the base metal. To-day it appears to be coming into its own, and the list of articles given by the authors as being regularly treated is remarkable in length and variety, ranging from wing-bolts and nuts to steel casements and iron pumps.

The description of the Sherardizing process gives an adequate general idea, but cannot attempt to impart knowledge which is largely an art. The real value of the publication lies in the practical manner in which the possibilities, scope, faults, and limitations and costs of the treatment are dealt with. The relations between the customer, Sherardizer and the manufacturer are dealt with. It is pleasing to see the necessity for perfect cleanliness of surface and surface composition of the Sherardizing articles emphasized, as lack of control of these factors has been to a great extent responsible for failures in the past, which have contributed in no small measure to the slow development of the practice in this country.

Some of the authors' chemical explanations are descriptive rather than complete, and an obvious error has crept in where zinc dust is said to decompose water with the liberation of nascent oxygen; but these are not at all material to the general thesis.

The authors adhere to the Passon test for protection evaluation. The Wenzland hydrogen peroxide-acetic acid test is probably superior.—**P. S. LEWIS.**

**Kohäsionsfestigkeit.** Von W. Kuntze. 8½ × 10½ in. Pp. 62, with 77 illustrations in the text. 1932. Berlin: Julius Springer. (R.M. 11.)

This brochure, appearing at the same time as Part 26 of the serial publication *Mitteilungen der deutschen Materialprüfungsgesellschaft*, contains, in effect, a review of recent theoretical and practical investigations into the elastic and plastic properties of materials which have been carried out at the Staatliches Materialprüfungsbüro, Berlin-Dahlem. Professor Kuntze, with Professor Dr. G. Sachs, who is well known to members of the Institute of Metals, has been responsible for much of the advance which has occurred within recent years in this comparatively

new field of research; his views, as set out in this brochure, can be accepted as authoritative. Dr. Krisch, who contributes three short sections to the work, has also done some work in this field. What exactly is meant by cohesion? The fundamental phenomenon is simplicity itself, and can be illustrated by the fact that when one end of, say, a rod, is moved, the rest of the rod follows. But why? Do I hear you say, "A childish question, it cannot do anything else"? Then I would ask, "And why cannot it do anything else"? and ultimately you would be compelled to answer, "Because of cohesive force, the force that makes the parts of a rod hold together." This is clearly arguing in a circle, and leads nowhere. This so-called cohesive force is what holds the parts of a body together when the body is stretched, rolled, or submitted to any of the working processes familiar to the practical metallurgist; in plastic deformation of a material cohesion is temporarily overcome, to assert itself again in the altered configuration after slip has occurred. It is clear, then, that the study of elastic and plastic strains can throw much light on the nature of cohesive force. This brochure sets out in considerable detail practical details of such study, and discusses some of the results hitherto obtained. Amongst the subjects discussed are: the influence of heterogeneity on tenacity, tensile and notched-bar tests, elastic fatigue, plastic flow, the practical point of view being stressed throughout. The book is very well printed on good paper; the illustrations and diagrams are very clear. A bibliography comprising references to 88 published works is appended. The price, considering the specialized character of the book, is not excessive, although perhaps a little high for British metallurgists, with the present rate of exchange.

—J. S. G. THOMAS.

**Elektrische Lichtbogenschweissung. Handbuch für die Anwendung der Lichtbogenschweissung in der gesamten Industrie.** Von Karl Meller. ("Elektrizität in industriellen Betrieben," Herausgegeben von W. Phillipi. Band III.) Zweite, wesentliche erweiterte Auflage. Sup. Roy. 8vo. Pp. xii + 398, with 374 illustrations. 1932. Leipzig: S. Hirzel. (Geb., R.M. 26; geb., R.M. 27.80.)

After a short historical introduction, Part I of this book discusses the different arc-welding processes and the fundamental characteristics of the electric arc. Part II describes the various types of welding plant, both a.c. and d.c.; their theoretical principles; static and dynamic characteristics; mechanical construction; and efficiency. Welding accessories are also described. Parts III, IV, and V deal with the arc-welding of steel, cast-iron, and the non-ferrous metals in 138, 14, and 3 pages, respectively. The section on steel includes a detailed account of welding costs, illustrated by diagrams and nomograms relating electrode costs, welding speeds, thickness of material, &c. A comparison is drawn between a.c. and d.c. welding and between arc and oxy-acetylene welding. There are then two short sections on cutting by means of the arc and the training of welders, and two long sections on testing welded joints and applications of arc welding.

Although there is an immense amount of information in the book, it is not quite comprehensive. The review of welding machines is extremely thorough, but dismisses very briefly the Alexander and Langmuir processes and does not mention the valve-rectified welder. Even the lengthy section on steel welding will be found wanting if information is required about alloy steels, and, as pointed out above, the space devoted to the non-ferrous metals is so inadequate as to be useless. The author is cautious in his views on the scope of arc welding, and, consequently, the number of varied applications which are described, is all the more impressive. He is cautious, too, when discussing the many phases of welding concerning which there is controversy, and one would have valued a more definite expression of opinion from an authority so well qualified to give it.

Although there are only three pages dealing specifically with his work, the non-ferrous welder will find this book of great value.—H. W. G. H.

**Die Elektrische Warmbehandlung in der Industrie.** Von E. Fr. Russ. Med. 8vo. Pp. v + 259, with 239 illustrations. 1933. München und Berlin: R. Oldenbourg. (Geb., M. 14.)

The field of electric heat-treatment furnaces is covered by this work, which provides a description of a wide variety of furnaces, and indicates the diverse services to which they are applied.

About two-thirds of the book deals with a description of individual furnaces, which are profusely illustrated—there are 239 figures, mostly reproductions of photographs. The remainder of the volume briefly explains the general principles and describes the constructional materials. The particular value of this volume lies in the fact that it gives a fairly up-to-date account of the latest applications of electric annealing and heat-treatment furnaces. The author's own designs are, of course, prominent, but many other German furnaces, and some American ones, are included. The British work on this subject, which is of first-class importance, is almost neglected.

**Technical Data on Fuel.** Third Edition, revised and considerably enlarged. Edited by H. M. Spiers. Cr. 8vo. Pp. xv + 302, with 57 figures and 210 tables. 1932. London: British National Committee, World Power Conference, 63 Lincoln's Inn Fields, W.C.2. (12s. 6d. net.)

The first edition of this book was published in 1928; the fact that a third edition is called for in 1932 is sufficient evidence that the work has been welcomed by fuel technologists. In the issue of this new edition, opportunity has been taken for a thorough revision of the work; the material treated is about 75 per cent. greater than that contained in the first edition, and about 33 per cent. greater than that of the second edition. The use of thinner paper has enabled the book to be reduced to pocket size; in one way this is an advantage, in another a disadvantage, as the print is now clearly visible through the blank unprinted pages provided for the insertion of notes. New material inserted in this edition includes: tables of logarithms and antilogarithms, sines, cosines, &c. (considering that the primary purpose of such tables is to expedite calculation, their clearness leaves something to be desired), British standard test sieves, thermometric lag, humidity tables, steam tables, properties of saturated vapours, including mercury, radiation from flames, permeability of refractory materials to gases, specific heats of waste gases from gaseous fuels.

Tables of especial interest to metallurgists include those relating to the specific gravity, melting and boiling points, and thermal expansion of metals and alloys, the composition of alloys, expansion of stainless steel, nickel, Monel metal, and aluminium, mechanical properties of copper, Duralumin, and "Y"-alloy at various temperatures, creep stress, uses of metals and alloys. There are sections devoted to refractories, solid, liquid and gaseous fuels, stack losses, and a bibliography. Here is meat indeed for the metallurgist and the fuel technologist. Where I have checked the data, I have found them reliable. Collections of chemical and physical data catering for the needs of the pure scientist (if the designation be permitted) we have in plenty, to mention only Kaye and Laby's "Tables," the "International Critical Tables" and the volume issued by the Société Française de Physique. Well, here in *Technical Data on Fuel* we have something of the same kind, and yet something entirely different, the practical scientist's Kaye and Laby. And anyone familiar with this latter work will know that this is, indeed, praise of *Technical Data on Fuel*. The book is published at a very reasonable price and will, no doubt, find its way on to the working desk of all metallurgists and fuel technologists. It is essentially a book to be used. I welcome the appearance of a third edition. My copy of the second edition is decipherable only with difficulty, through continual use in laboratory and workshop.—J. S. G. THOMAS.

**Pulverized Fuel Firing.** By Sydney H. North. Cr. 8vo. Pp. ix + 193, with 62 illustrations. 1932. London: Sir Isaac Pitman & Sons, Ltd. (7s. 6d. net.)

Where exactly are we in the matter of industrial fuel? A little while back, Sir Frank Smith, Secretary of the Department of Scientific and Industrial Research, confidently asserted that the hydrogenation of coal was an economic proposition; his statement was quickly and equally confidently contradicted by Mr. H. T. Tizard, his predecessor in that office. What of low-temperature carbonization? The virtues of more than one process have been lauded to the skies. Where are they to-day? And what of pulverized fuel? Initiated in the United States in 1915,\* it was introduced into Great Britain in 1923, and was instantly boomed as the industrial fuel *par excellence*. Very little, save for occasional journalistic reference to the firing of a transatlantic liner with colloidal fuel, a suspension of pulverized fuel in fuel oil, has been heard of it lately. It is therefore all the more refreshing to read that "its adoption for firing large units has rapidly increased, and a few years only has [sic] seen the new form of firing gain an established position" and "developments point to the probability that pulverized fuel firing will, during the next few years, witness a very great extension of its application." Published data suggest that progress in America and Germany has been considerable; in Great Britain "progress has also been remarkable, though no figures are available relative to consumption." This last quotation epitomises the whole fuel position—all is nebulous.

This little book will do much to clarify the position so far as pulverized fuel firing is concerned. It gives up-to-date information on modern processes of fuel combustion, furnace equipment, dust collectors, and pulverizing mills. Important installations are illustrated, and a considerable amount of valuable data is arranged in tabular and diagrammatic form. Although the book is intended primarily for engineers concerned with land and marine boilers fired with pulverized fuel, it is not without interest to the metallurgist, for Chapter XI is devoted to the use of pulverized fuel in metallurgical industries, including the production of nickel and copper.

\* Writers on the subject appear to be unaware of the fact, to which my attention has been drawn by a member of the Publication Committee of the Institute, that cement kilns in Great Britain have been fired with pulverized fuel for the last 50 years. Verily, there is no new thing under the sun!—J. S. G. T.

The book is one that can be confidently recommended to fuel technologists and industrialists generally; it is clearly printed on good paper, is well bound and illustrated and is very reasonable in price.—J. S. G. THOMAS.

**Annual Tables of Constants and Numerical Data, Chemical, Physical, Biological, and Technological.** 4to. Volume VIII (1927-1928) Part I. Pp. xl + 1101. Part II. Pp. xxi + 1102-2706. 1931. (500 francs.) Volume IX (1929). Pp. 1 + 1607. 1932. (400 francs.) New York: McGraw-Hill Book Co., Inc.; Paris: Gauthier-Villars et Cie.

The issue of these further volumes emphasizes in a very marked degree the vast amount of investigation which is being carried on at the present time and the almost impossible task which confronts anyone who sets out to become acquainted with all that is being published in even a circumscribed sphere. The publication of these annual summaries of data is, indeed, a boon to those who want recent information quickly. They also serve to maintain the historical sequence of research work on particular subjects. They facilitate comparisons between the results obtained by different observers, and also assist in establishing the bases for further work. But there are some inherent disadvantages. In the first place, there is no attempt at a critical discussion of results bearing on similar themes, nor is there any description of the methods by which they were attained. Bare facts, as originally presented by the authors, are inserted, and although those who have been responsible for the compilation may have used discriminatory powers, the data, nevertheless, suffer from the lack of ordered and thoughtful discussion and comparison. The reader has therefore to use his own discretion and to sum up the relative importance of the details that are given as best he may, or else turn to the original papers, to which references are invariably given. In the second place, these summaries, cannot, in the nature of things, even now be complete. The very wide extent of the survey of inorganic and organic materials and the exceedingly larger number of chemical and physical properties which have now to be taken into consideration, involving a search in magazines and journals the world over, make the task of cataloguing the results gigantic and almost incapable of reaching finality, even over a short period.

These are general criticisms, however, which were no doubt foreseen when the original volume was contemplated. They do not detract from the great value of this collection of data both to the research worker, to whom it is necessary that he should know what the results of previous workers were, or to the mere inquirer who is simply in search of facts. The information is given clearly, mostly in tabular form, but, where necessary, curves are added to assist in correlation. In all references and general textual matter both the English and the French languages are used, which widen very considerably the sphere which the volumes may serve. It is impossible—nor is it desirable—to enumerate the various scientific fields which have been covered. Suffice it to say that an attempt has been made to record all recent information published within the periods named, thus forming a compendium of statistical knowledge, which is being increased year by year, and which is of inestimable value to those to whom facts are essential. Their relative importance compared with others already published, and obtained possibly by other methods, rests finally with the reader.—W. A. C. NEWMAN.

**Mechanical Catalog 1932-33.** Twenty-second annual volume. 4to. Pp. 452. 1932. New York: American Society of Mechanical Engineers.

The twenty-second annual edition of this useful catalogue provides information descriptive of the products of 306 American manufacturers of mechanical apparatus and related materials classified into eleven sections for ready reference. These sections, which amply illustrate the scope of the book, are as follows: power plant equipment; measuring and testing apparatus; power transmission machinery; materials handling equipment; metals, alloys, and other materials; foundry, rolling-mill, and forge equipment; metal-working machinery, machine tools, and shop equipment; compressors, blowers, and pumps; heating and ventilating equipment, refrigerating machinery; specific industry machinery, general industrial equipment; electric motors and control. Finally, there is a 63-page index, showing the suppliers of various plant and the page on which their advertisement appears.—A. R. POWELL.

**Marlborough's German Technical Words and Phrases. English-German and German-English Dictionary.** Third Edition, enlarged and revised by E. M. Rolfes. Demy 8vo. Pp. iv + 188. 1931. London: E. Marlborough & Co., Ltd. (7s. 6d. net.)

This is essentially a technical dictionary, in that it contains only those words which are used in a scientific, trade, or professional sense. The book is well arranged, and contains a large selection of useful words, but the metallurgical terms are not by any means complete, e.g. such common words as *Hütte* and its derivatives, *Rotguss*, *Kupferstein*, *Jagermetall*, and the terms used for the mechanical properties of metals are not included. The book will probably be found much more useful by business men than by the scientific worker.—A. R. POWELL.