

METALLURGICAL ABSTRACTS

(GENERAL AND NON-FERROUS)

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Part 12

I.—PROPERTIES OF METALS

(Continued from pp. 657-660.)

The Behaviour of Hydrogen and Nitrogen towards Aluminium. P. Röntgen and H. Braun (*Metallwirtschaft*, 1932, 11, 459-463, 471-472; and (abridged translation) *Light Metals Research*, 1932, 2, (14), 2-7).—The gas absorption of aluminium and Veral has been determined by measuring the decrease in volume of the particular gas when brought into contact with the molten metal contained in an alumina crucible and completely degassed by heating *in vacuo*. Absorption of hydrogen at atmospheric pressure rises from 0.001 c.c./gram. of aluminium at 700° C. to 0.04 c.c./gram. at 1000° C. At constant temperature the values are proportional to the square root of the gas pressure. No nitrogen is absorbed between 700° C. and 1000° C., as a surface film of aluminium nitride is formed which prevents diffusion of the gas into the metal.—v. G.

Beryllium. Alfred Stock (*Trans. Electrochem. Soc.*, 1932, 61, 255-272).—See *J.*, this volume, p. 337, and following abstract.—S. G.

Discussion of Alfred Stock's Paper on "Beryllium." H. C. Claffin. C. G. Fink. P. H. Bracc. J. D. Edwards. J. Schulein. M. Merlub-Sobel (*Trans. Electrochem. Soc.*, 1932, 61, 272-274).—Cf. preceding abstract. H. C. C. asserts that a metal fog is often experienced when working the beryllium bath at higher temperatures. J. D. E. is of the opinion that no special properties of beryllium-copper alloys have so far been disclosed which make the extra expense worth while. M. M.-S. holds that the brittleness is due to films of non-metallic constituents rather than to hardness of the metal.—W. A. C. N.

A Simple Method of Measuring the Specific Heat of a Solid Body at Ordinary Temperature. Application to Beryllium. P. Vernotte and A. Jeufroy (*Compt. rend.*, 1931, 192, 612-614; and (abstract) *Génie civil*, 1931, 98, 303; *C. Abs.*, 1931, 25, 2633).—A method is very briefly described for determining the specific heat of solids without the temperature uncertainties encountered in the usual procedure. The solid is allowed to come to a constant temperature in a thick, tightly closed metal box and is then dropped into cold water in the calorimeter and the reading is recorded. This method can be used for higher temperatures, in which case an oven is used to regulate the temperature. Beryllium was found to have a specific heat of 0.397 at 13° C.—S. G.

Researches on Beryllium. Heinz Borchers (*Abhandl. Inst. Metallhütt. u. Elektromet. Tech. Hochschule, Aachen*, 1932, [N.F.], 1, 4 pp.).—Reprinted from *Metallwirtschaft*, 1931, 10, 863-866. See *J.*, this volume, p. 145.—A. R. P.

The Effect of Transverse Magnetic Fields on the Thermal Conductivity of Bismuth at Low Temperatures. E. J. Knapp (*Phys. Rev.*, 1932, [ii], 39, 550).—Abstract of a paper read before the American Physical Society. A vacuum conductivity method was employed to observe the thermal conductivity of polycrystalline bismuth in transverse magnetic fields ranging from zero to 11,000 gauss. Two series of observations were made. In the first series the average temperature of the specimen was -160° C.; in the second series it was -119° C. The variation of the relative decrease in thermal conductivity with magnetic field strength was found to fit the equation, $\Delta\kappa/\kappa = BH^2/(1 + CH^2)$. The maximum decrease was 28.9% in the first series of observations and 24.0% in the second series. In the first series the point of inflection of the curve, $\Delta\kappa/\kappa$ against H , appeared at about 1/9th of the maximum field strength; in the second series it appeared at about 1/5th of the maximum field strength. This work is being extended to single crystals.

—S. G.

Metamagnetism in Bismuth Single Crystals. A. B. Focke and A. Goetz (*Phys. Rev.*, 1932, [ii], 39, 548).—Abstract of a paper read before the American Physical Society. The influence of the presence of foreign atoms within the lattice of bismuth crystals on the magnetic susceptibility (χ_{\perp} and χ_{\parallel}) is studied for the cases of bismuth-lead, bismuth-tin, and bismuth-germanium. In all cases the foreign atom is enantiomorphic and thus cannot replace a bismuth atom. So long as the concentration is below the solubility limit (0.5–5%) foreign atoms always cause an increase of the magnetic anisotropy as well as an increase of its temperature coeff. Thus the normal anisotropy of pure bismuth crystals ($\chi_{\perp}/\chi_{\parallel} = 1.425$) (Focke, this *J.*, 1930, 44, 449) can increase in the case of a tin concentration at the solubility limit (ca. 3%) to values of 10^4 (Goetz and Focke, *J.*, this volume, p. 66). At lower temperatures χ_{\parallel} decreases to zero, and below -3°C . the crystal is paramagnetic parallel to the axis and stays diamagnetic normal to it. Measurements of the quantitative effect of concentrations of foreign atoms (beginning at 0.005% lead) yielded the following empirical formula for inverse magnetic anisotropy of bismuth: $\chi_{\parallel}/\chi_{\perp} = R = R_0 - (\beta_0 + \alpha_0 \cdot N\phi) \cdot (T_0 - T) \dots$, where T = abs. temperature; T_0 = temperature at which the influence of foreign atoms on the anisotropy disappears; $R_0 = R$ for $T = T_0$; β_0 = temperature coeff. of R for purest bismuth; N = concentration of foreign atoms; α_0 = effect of one foreign atom on R ; $\phi = (N/\alpha) \cdot (d\alpha/dN)$. The values obtained for bismuth are $T_0 = 813^{\circ} \pm 5^{\circ}$ abs.; $R_0 = 0.95$; $\phi = 0.5 \pm 0.005$. Hence α is the only constant which depends on the type of impurity. Lead and tin follow the relation over the whole range of temperature, whereas germanium shows at high temperatures deviations which seem to indicate the formation of an intermetallic compound. The influence of dissolved foreign atoms is too large to be accounted for in terms of a statistical volume distribution. It seems necessary to assume an adsorption in the internal surface of the crystal due to the boundaries of its secondary structure. Approximate calculations give the same value for the parameter of this structure (ca. 10^{-4} cm.) as was previously observed (Goetz, this *J.*, 1930, 43, 521).—S. G.

Hardness of Chromium. R. Schneidewind (*Metallurgist* (Suppt. to *Engineer*), 1932, 8, 108–110).—A summary of a paper by S. and discussion, in *Trans. Amer. Soc. Steel Treat.*, 1931, 19, 115–132. See *J.*, this volume, p. 338.
—R. G.

Copper Embrittlement. L. L. Wyman (*Amer. Inst. Min. Met. Eng. Preprint*, 1931, Sept., 1–11).—The relative merits of several different kinds of copper as judged by their resistances to embrittlement under given operating conditions have been studied. The metal was exposed under known conditions, alternately to oxidizing and reducing atmospheres, over a range of temperatures not exceeding 900°C . in the former instance and 800°C . in the latter. Samples of each brand of copper were subjected to three different heat-treatments: (1) heating in a muffle for 15 minutes at temperatures between 400° and 900°C .; (2) heating as in (1), but for 30 minutes; (3) treating the samples from (1) and (2) for 15 minutes at various temperatures in a hydrogen tube furnace. After microscopical examination, graphs were drawn showing the depth of penetration of cracking in relation to the different treatment conditions. In general, it has been found that there is no definite range within which copper, as represented by the brands treated, is particularly susceptible to cracking. Purified (vacuum) and deoxidized coppers are more resistant to cracking than ordinary commercial copper, the extent of the resistance being dependent on the type of purification and nature of the deoxidant used. They may be rated in the following order: (1) zinc-deoxidized copper; (2) silicon-deoxidized copper; (3) calcium boride-deoxidized copper; (4) vacuum copper; (5) silicon and phosphorus-deoxidized copper; (6) commercial copper.—W. A. C. N.

Masked Hydrogen Sickness of Brittle Copper Wires. C. Schaarwächter (*Z. Metallkunde*, 1932, 24, 234–235; discussion, 235–236).—Hair cracks in

copper wire bars are *inter alia* an infallible criterion for hydrogen sickness. During rolling and drawing of wire bars which have been annealed in a reducing atmosphere the hair cracks gradually disappear. Hence brittleness in copper wire may be due to hydrogen sickness, although no hair cracks can be detected in the microstructure.—M. H.

Analytical Investigation of the Case of a Copper Firebox Plate, Said to have been Burnt in Fitting. Anon. (*Maschinenkonstrukteur*, 1931, 64, (11), 132).—A case of embrittlement in the flanged portion of a firebox plate is described. Failure was at first attributed to burning, but microscopic and analytical examination showed that both heat-treatment prior to fitting and the composition of the material were at fault. On analysis 3% of arsenic and 9% of other impurities were found.—P. M. C. R.

The Creep of Lead and Lead Alloys Used for Cable Sheathing. Herbert F. Moore and Norville J. Alleman (*Univ. Illinois Bull.*, 1932, 29, (*Eng. Exper. Sta. Bull.* No. 243), 5-26).—Creep tests made at 32° and 150° F. (0° and 65° C.) on pure lead and on lead alloys containing 1, 2, or 3% tin, or 0.75 or 1% antimony, or 0.04% calcium showed that continuing creep occurs with stresses as low as 150 lb./in.², although the tensile strength of the materials is 1530-3850 lb./in.². Short-time tensile tests on the calcium alloy showed that increased pulling speed increased the tensile strength values. No absolute creep limit was found for any of the metals tested, but graphs showing stress as ordinates and hours required to produce a 1% creep as abscissæ (log scale) showed a distinct flattening-out tendency, and in some cases seemed to be approaching a horizontal asymptote. Tests made with an arbitrary method of determining a practical creep limit indicated that a value of 200 lb./in.² may be deemed a fair average practical creep limit for this type of alloy at 32°-150° F. (0°-65° C.). Increase of temperature accelerates creep at the higher stresses. Definite creep has been observed in full-size specimens under stresses of 200 lb./in.², but the average rate of creep is less than in the test specimens.—A. R. P.

The Diffusion of Metals in Solid Lead.—I. W. Seith and F. G. Laird (*Z. Metallkunde*, 1932, 24, 193-196; and (summary) *Metallurgist* (Suppt. to *Engineer*), 1932, 8, 158-160).—The rate of diffusion of silver, bismuth, thallium, tin, and lead in lead at 220°, 245°, 265°, and 285° C. decreases in the order named, *i.e.* with an increase in the chemical affinity between the metal and the lead. The diffusion constants of the above metals into lead are silver 790, bismuth 3.8, thallium 2.7, tin 1.4, and lead 0.6 (all $\times 10^{-5}$ cm.²/day).

—M. H.

Purity of Mercury. Anon. (*J. Franklin Inst.*, 1931, 212, 800-801).—A note from the Bureau of Standards. The presence of 0.001% of metals such as zinc, tin, lead, cadmium, bismuth, copper, magnesium, or antimony so changes the appearance of mercury that it would by observation appear to be badly contaminated. The presence of gold or silver even up to 0.1%, however, cannot be detected by the appearance of the mercury. This indicates that mercury that is clean and bright and does not wet a glass surface cannot contain more than very minute amounts of base metal.—S. V. W.

Temperature Changes Accompanying Magnetization in Nickel. Agnes Townsend (*Phys. Rev.*, 1932, [ii], 40, 120).—Abstract of a paper read before the American Physical Society. The object of this investigation was to determine the relation between temperature and magnetic field intensity in a specimen of polycrystalline nickel during a single cycle of magnetization. The method used was that described by Ellwood (*Phys. Rev.*, 1930, [ii], 36, 1066). The ellipsoidal test-specimen was composed of 104 hard-drawn nickel rods of 1 mm. diam. The purity of the nickel was indicated by the following analysis: copper 0.07, iron 0.18, manganese 0.044, silicon 0.21, carbon 0.065, nickel 99.42%. The following is typical of the behaviour of this material: on reducing the magnetic field intensity in successive steps from 230 gauss, the temperature

increases gradually and then more rapidly until the knee of the hysteresis curve is turned, after which the temperature decreases sharply and then more gradually until the initial magnetization is completely reversed. Thus the H - T curve has a cusp in the region in which the intensity of magnetization is changing most rapidly. The temperature at this point is 4 times the final rise in temperature for the half cycle. The sharp minimum near $J = 0$ observed by Ellwood in carbon steel is entirely absent in nickel.—S. G.

Reversals of Hall Effect in Tellurium. P. I. Wold (*Phys. Rev.*, 1932, [ii], 40, 128).—Abstract of a paper read before the American Physical Society. W. has previously reported (*ibid.*, 1916, [ii], 7, 169) on the galvano- and thermomagnetic properties of tellurium. An outstanding characteristic was that, as the temperature rose, the Hall effect changed from a large positive value to a negative value and then to a positive value. An explanation was suggested on the basis of 2 crystalline forms of tellurium. The specimen last worked with at that time has been preserved and now has been restudied both to see what changes may have occurred in that time and to examine more fully the effects of different heat-treatments. The same remarkable double reversal of the Hall effect was found. By very slow cooling from 300° C. there comes a point, below 50° C., where the Hall constant changes from about - 600 to about + 700 in a 20° range. On the other hand, the Hall constant may be kept always positive. The changes in resistance of tellurium, with temperature, were also observed. The present behaviour can, it seems, be best explained on the basis of 3 forms of tellurium, with transition points in the general neighbourhood of 50° C. and 240° C.—S. G.

The "Cry" of Tin. Bruce Chalmers (*Tin*, 1932, Aug., 14-15).—Abstract of an article in *Nature*, 1932, 129, 650-651. See *J.*, this volume, p. 420.—J. H. W.

Evaporation and Migration of Thorium on Tungsten. Walter H. Brattain (*Phys. Rev.*, 1932, [ii], 40, 1044).—Abstract of a paper read before the American Physical Society. The work reported in abstract (this *J.*, 1930, 44, 463) has been continued. Thorium evaporates from a tungsten surface at an appreciable rate at 2200° K. The evaporation rate depends on the temperature and the fraction of the surface covered (f). Except for values of $f < 0.2$, the rate of evaporation is approx. an exponential function of f . The rates of evaporation determined by Langmuir (this *J.*, 1926, 35, 494) and Andrews (this *J.*, 1929, 41, 411) are comparable with the above results when account is taken of the difference between Langmuir's parameter θ and the present author's f . It was found that thorium could be deposited on one side of a tungsten ribbon and then made to migrate to the other side by flashing the tungsten ribbon at 1535°-1655° K. This could be done without loss of thorium due to evaporation. The thorium lost from the front side Δf_1 was always equal to the amount gained by the back Δf_2 . This constitutes a proof that f is proportional to the amount on the surface. The rates of migration were determined at 1535° and 1655° K. They depend on the difference in concentration ($f_1 - f_2$) in much the same way as the rate of evaporation depends on f .—S. G.

On the Thermo-Electric Behaviour of Tungsten, Molybdenum, and Tantalum. A. Schulze (*Z. Metallkunde*, 1932, 24, 206).—The thermo-electric power of molybdenum, tungsten, and tantalum against platinum is - 0.49, + 0.40, and + 0.10 m.v., respectively, at - 190° C., reaches a minimum between - 190° and 0° C., and increases to 13.73, 11.92, and 5.61 m.v. at 600° C. and 42.73, 43.04, and 25.40 m.v., respectively, at 1300° C. The thermo-electric power of tantalum against tungsten is + 0.30 m.v. at - 190°, - 0.05 at - 80°, + 0.35 at 100°, 6.31 at 600°, and 17.64 at 1300° C. The thermo-electric power of the couple tungsten-molybdenum reaches a maximum of only 2 m.v. at 650° and then decreases to - 0.68 m.v. at 1400° C.—M. H.

Heat-Treatment of Fine Metallic Suspensions. N. N. Zirbel and A. B. Bryan (*Phys. Rev.*, 1932, [ii], 39, 857).—Abstract of a paper read before the

American Physical Society. See N. N. Zirbel, *Physics*, 1932, 2, 134-138; *J.*, this volume, p. 342.—S. G.

The Thermal Expansion of Zinc. II. Sieglerschmidt (*Z. Metallkunde*, 1932, 24, 198-200).—Determinations of the thermal expansion of pure zinc (99.99% and 99.95%), and of zinc containing 0.5% cadmium in the cast and in a homogenized condition (obtained by quenching from 350°-390° C.) reveal the great influence of composition and preliminary treatment on the position and distinctness of the expansion and contraction anomaly at 150°-200° C. which has often been regarded as a transformation point of zinc. This anomaly is, however, due to the dissolution and re-precipitation of impurities (cadmium, copper, iron, lead) by the heat-treatment. Homogenized samples of 99.99% zinc show no anomaly on heating to 240° C. A cadmium content of 0.5% has no influence on the distinctness of the thermal effect.—M. H.

The Shapes of Growing Metal Crystals. G. Tammann and K. L. Dreyer (*Z. anorg. Chem.*, 1932, 205, 77-80).—See *J.*, this volume, p. 420.—B. Bl.

Recovery [of Metals] from Cold-Work. G. Tammann (*Z. Metallkunde*, 1932, 24, 220-222; discussion, 222-223).—The recovery of cold-worked metals on annealing takes place at a lower temperature than the recrystallization, i.e. a cold-worked metal can be partly softened without appreciable change of structure. With constant deformation certain properties (hardness, electrical resistance, thermo-electric power, &c.) of copper, silver, and gold, recover within the same temperature interval. Aluminium behaves quite differently: the electrical resistance and thermo-electric force remain practically unchanged, whereas the hardness decreases within the wide range of 200°-350° C. The hardness, electrical resistance, and thermo-electric force of iron recover at 500°-600°, 100°-500°, and 100°-350° C., respectively; the corresponding temperatures for nickel are 600°-700°, 100°-750°, and 100°-350° C. The hardness of palladium and platinum also recovers at a much higher temperature than the electrical resistance. It is concluded that the recovery from cold-work of metals which belong to the same group of the periodic system takes place in the same way.—M. H.

Fatigue Cracks and their Propagation. A. Thum and H. Oschatz (*Metallurgist* (Suppt. to *Engineer*), 1932, 8, 155-156).—A summary of a paper by T. and O. in *Z.V.d.I.*, 1932, 76, 132. See *J.*, this volume, p. 342.—R. G.

The Hardness of Electrolytic Metals. — Guichard, — Clausmann, and — Billon (*Technique moderne*, 1930, 22, 732).—Abstract of paper read before the 6e Congrès International des Mines, &c. See this *J.*, 1931, 47, 329, 373.—H. W. G. H.

Fresh Data on the Influence of Occluded Gases on the Mechanical Properties of Metallurgical Products. Léon Guillet, Albert Roux, and Jean Cournot (*Compt. rend.*, 1931, 193, 685-687; and (slightly abridged translation) *Light Metals Research*, 1931, 1, (30), 30-31).—The authors, continuing a previous investigation (see this *J.*, 1931, 47, 329 and 373), state in reply to Guichard, Clausmann, Billon, and Lanthony (see this *J.*, 1931, 47, 329 and 373), that (1) they have heated electrodeposited metal to 350° C. for 24 hrs. without affecting the hardness; (2) occluded hydrogen is still present when the hardness begins to decrease; (3) at temperatures above 350° C. still more hydrogen was obtained, without, however, the entire content having been extracted. They hence conclude that it is impossible to state definitely that the hardness is entirely independent of hydrogen content. Since the hydride previously noted dissociates above 250° C., the relation of hardness above this temperature must be attributed to dissolved hydrogen, some of which is produced by the dissociation of the hydride.—P. M. C. R.

Solutions of Metals in Non-Metallic Solvents; Some of the Physical and Chemical Properties. Charles A. Kraus (*J. Franklin Inst.*, 1931, 212, 537-562; and (summary) *Metallurgist* (Suppt. to *Engineer*), 1932, 8, 72-74).—The

alkali metals and the metals of the alkaline earths dissolve in liquid ammonia with the formation of ions. The positive ions are the normal ions of these metals, whilst the negative ions are electrons. Metallic compounds, when they dissolve in liquid ammonia, form ions of the normal type. The more electro-negative element forms the anions.—S. V. W.

On the Dependence of the Specific Heat on Temperature for the Elements of the Eighth Group of the Periodic System. F. M. Jaeger (*Z. anorg. Chem.*, 1931, 203, 97-103).—A summary of the work of Jaeger and Rosenbohm on the sp. heat and heat of transformation of the elements platinum, osmium, iridium, ruthenium, rhodium, palladium, iron, cobalt, and nickel (cf. *Proc. K. Akad. Wet. Amsterdam*, 1927, 30, 905, 1069; 1930, 33, 457; 1931, 34, 808 (cf. *J.*, this volume, p. 418); *Rec. trav. chim.*, 1928, 47, 513; 1931, 50, 1035).—B. Bl.

Measurements on the Electrical Resistance of Some Metals below the Boiling Point of Oxygen. W. Tuyn (*Proc. K. Akad. Wet. Amsterdam*, 1929, 32, 115-123; and *Comm. Phys. Lab. Univ. Leiden*, 1929, (196), 21-30).—[In English.] Measurements on the electrical resistance of cadmium, copper (crystals), gold, indium, lead, platinum, thorium, zinc, and tin (single crystals) are given for temperatures below 90° K.—S. G.

A Theory of the Change of Electrical Resistance in Metals Caused by Cold-Working. Kôtarô Honda and Tokutarô Hirone (*Kinzoku no Kenkyu*, 1932, 9, (7), 315-320).—[In Japanese.] The changes of electrical resistance in metals caused by cold-working in the elastic region are explained by the Hôjendahl-Frenkel theory of free electrons, based on the Thomas-Fermi theory of electron distribution around the nucleus of the atom, and by taking account of the mutual impacts of free electrons. Generally speaking, the agreement between the theory and experiment is satisfactory.—S. G.

The Emission of Positive Ions from Heated Metals. LeRoy L. Barnes (*Phys. Rev.*, 1932, [ii], 40, 1044).—Abstract of a paper read before the American Physical Society. Filaments of iron and nickel have been heated in a mass spectrograph, and at temperatures just below their melting points it is found that singly-charged atoms of iron and nickel are emitted. Similar attempts to obtain positive ions of platinum, uranium, and thorium have not met with success. Rhodium and columbium ions have been obtained, which is in agreement with the results already reported by H. B. Wahlin.—S. G.

II.—PROPERTIES OF ALLOYS

(Continued from pp. 660-665.)

Light Metal Sand-Castings; their Static and Vibration Strength. W. Saran (*Z. Metallkunde*, 1932, 24, 181-184, 207-210).—Complete stress-elongation, stress-bending, and stress-slip diagrams have been constructed from the results of static tests and the vibration strength has been determined under dynamic tension-compression, bending, and torsional loads for the following commercial sand-cast alloys: 86:12:2 aluminium-zinc-copper alloy, 94:6 and 86:14 aluminium-copper alloy, 88:12 aluminium-silicon alloy, KS-Seewasser, Lantal, age-hardened Alufont, and Elektron AZG (containing aluminium 5 and zinc 2.4%). The results show that there is no clear relation between the dynamic endurance strength and the static elastic limit, yield-point, or tensile strength.—M. H.

Testing of Light Metals for the Construction of Cylinders [of Internal Combustion Engines]. Paul Sommer (*Forschungsarb. Metallkunde u. Röntgenmetallographie*, 1932, (4), 1-47).—Curves are given showing the friction resistance and hardness of numerous aluminium and magnesium light alloys at various

temperatures and the effect thereon of heat-treatment. The most important results are tabulated together with data on the thermal conductivity and coeff. of expansion.—A. R. P.

Dilatometric Investigations of the Thermal Effect During the Annealing of Duralumin and its Constituents. M. Haas and H. Hecker (*Abhandl. Inst. Metallhütt. u. Elektromet. Tech. Hochschule, Aachen*, 1932, [N.F.], 1, 8 pp.).—Reprinted from *Z. Metallkunde*, 1929, 21, 166–173. See this *J.*, 1929, 42, 434.—A. R. P.

Ultralumin. F. Bollenrath (*Luftfahrtforschung*, 1929, 6, (1), 18–32; and (abstract) *Z. Flugtechnik*, 1930, 21, 118).—Ultralumin "U11" is an aluminium-copper alloy, free from magnesium, the strength of which can be increased by artificial ageing. The melting point is 645° C.; forging temperature, 460°–480° C.; heat-expansion coeff., 0.00022; temperature resistance coeff., 0.00218; modulus of elasticity, 6900–7300 kg./mm.²—S. G.

The New Silumin Catalogue. Anon. (*Automobiltech.-Zeit.*, 1929, 32, 769; *Eng. Index*, 1930).—Although called a "catalogue," this publication is a scientific treatise on modern methods and uses of aluminium alloys. It discusses the metallurgy of aluminium alloys, gives micro- and macro-photographs, and deals with physical and chemical properties with reference to modern strength and corrosion requirements. The publication referred to is stated to have been ordered for class-room purposes by several technical universities.—S. G.

[**"Lo-Ex" Aluminium Alloy.**] Anon. (*Machinery (N.Y.)*, 1930, 37, 23).—A brief description of No. 132 or "Lo-Ex" alloy (*i.e.* low expansion) developed by the Aluminum Company of America. Intended primarily as a material for pistons, it contains 14% silicon with nickel, magnesium, and copper. The sp. gr. is about the same as that of pure aluminium, whilst the coeff. of expansion is low and the thermal conductivity high.—H. F. G.

Precipitation Hardening [Illustrated by] Photomicrographs. A Contribution to the Micrography of Aluminium Alloys. H. Röhrig (*Z. Metallkunde*, 1932, 24, 231–233).—Photomicrographs are discussed of cast, slowly cooled, and rolled samples of an aluminium alloy with copper 4.8, silicon 1.2, and manganese 0.5%, after annealing at different temperatures followed by quenching or slow cooling and after quenching and ageing at different temperatures. From the number and shape of the particles precipitated from solid solution, conclusions may be reached as to the physical and chemical state and the nature of the heat-treatment undergone by a particular specimen of an age-hardenable aluminium alloy.—M. H.

On the History of the Development and Theory of Age-Hardenable Rolling Alloys of Aluminium. G. Sachs (*Z.V.d.I.*, 1932, 76, 829).—A review, with extensive bibliography, of the developments in age-hardening aluminium alloys since Wilm's discovery of the hardening process in 1909.—v. G.

Röntgenographic Contributions to the Problem of Age-Hardening [of Aluminium Alloys and Britannia Metal]. Oskar Summa (*Forschungsarb. Metallkunde u. Röntgenmetallographie*, 1932, (1), 1–43).—An X-ray examination of zinc-aluminium casting alloys containing small quantities of copper and magnesium has been made immediately after casting and at intervals up to 14 days' ageing at room temperature. The results show that the initial increase in hardness is due to separation of zinc from solid solution, but that the later increases are due to separation of Cu₂Mg. Similar effects occur with copper-aluminium alloys containing magnesium. The increase in hardness of Britannia metal during annealing at 175° C. is due to the separation not of a copper-tin compound, as stated by Egeberg and Smith (this *J.*, 1928, 40, 527, and 1929, 42, 464), but of SnSb; this separation occurs only when the cast metal has been rolled with a reduction of at least 50%.—A. R. P.

Age-Hardening Investigations on the Zinc-Aluminium Alloy with the Composition Al₂Zn₃. Herbert Meyer (*Forschungsarb. Metallkunde u. Rönt-*

genmetallographie, 1932, (2), 1-50).—On quenching an alloy containing 40 atomic-% of aluminium and 60 atomic-% of zinc from above 280° C. and ageing at room temperature the electrical resistance rises rapidly to more than double its normal value, then falls somewhat less rapidly. The presence of small quantities of cadmium or magnesium retards the rate of rise and, more markedly, the rate of fall as well as reducing the maximum obtained. At 50° C. the rates of rise and fall of resistance are greatly increased, but the curve does not become flatter, although the maximum resistance obtained is higher the lower the ageing temperature. Ageing tests at different temperatures and after various preliminary treatments indicate that the rise in resistance is not due to the separation of a new constituent; it is suggested that this rise is due to increasing irregularities in the atomic arrangement in the lattice. On ageing at 100° C. no measurable rise occurs, but the resistance slowly falls due to the separation of the stable phase.—A. R. P.

Age-Hardening Investigations on the Zinc-Aluminium Alloy with the Composition Al_2Zn_3 . Herbert Meyer (*Z. Physik*, 1932, 77, 138).—It is noted that the complete text of M.'s work on this subject, which was published in abstract in *Z. Physik*, 1932, 76, 268 (see *J.*, this volume, p. 472), has now been published in the new publication *Forschungsarbeiten über Metallkunde und Röntgenmetallographie*, 1932, (2), 1-50; see preceding abstract.—J. T.

The Effect of Compensation by Stretching after Quenching. W. Fraenkel (*Z. ges. Giesserei-Praxis: Das Metall*, 1930, 51, 204).—Abstract of paper read before the Deutsche Gesellschaft für Metallkunde. See *J.*, this volume, p. 10.—J. H. W.

Strength in Shear of Thin Curved Sheets of Alclad. G. M. Smith (*U.S. Nat. Advis. Cttee. Aeronautics, Tech. Notes No. 343*, 1930, 1-27).—A description of experiments with regular "17ST" Duralumin with a coating of pure aluminium on each surface. The length of the test sheet was 24 in., with the material curved to form a quadrant of a circle. Four gauges were used, the thicknesses in thousandths of an inch being: 0.010, 0.014, 0.020, and 0.032. The buckling strength and breaking points are illustrated by means of graphs.—S. G.

Investigations on Duralplat Sheet. K. Schraivogel and E. K. O. Schmidt (*Z. Flug. u. Motor.*, 1932, 23, 320).—Summary of a paper read before the Deutsche Versuchsanstalt für Luftfahrt and also published in *Z. Metallkunde*, 1932, 24, 57-62. See *J.*, this volume, p. 424.—P. M. C. R.

Researches on Beryllium. Anon. (*Technique moderne*, 1930, 22, 432-433).—Extract from *Wiss. Veröff. Siemens-Konzern*, 1929, 8, (1), the papers in which have been abstracted (this *J.*, 1929, 42). The constitution and properties of the binary alloys with copper, nickel, and iron, and some complex alloys are briefly discussed.—H. W. G. H.

An Electrochemical Investigation of Solid Cadmium-Gold. Arno Ölander (*J. Amer. Chem. Soc.*, 1932, 54, 3819-3833).—A completed phase diagram of the cadmium-gold system is given, incorporating results of the present work which include three new transitions.—R. G.

On Complex Systems with Iron. IV.—The Systems Chromium-Carbon and Iron-Chromium-Carbon. E. Friemann and F. Sauerwald, with a supplement by A. Wintrich (*Z. anorg. Chem.*, 1931, 203, 64-74).—The melting point of chromium lies between 1915° and 1925° C. In the binary system chromium-carbon there are three intermediate compounds: Cr_4C (5.45% carbon), Cr_2C_3 (9% carbon), and Cr_3C_2 (in alloys with more than 9.1% carbon). Chromium and Cr_4C form a eutectic at 4% carbon and 1510° C. Cr_4C is not formed directly from the liquid phase, but by a peritectic reaction at 1540° C. On rapid solidification from above 1550° C. a metastable Cr_7C_3 -chromium eutectic (4.5% carbon, 1475° C.) is formed instead of the stable Cr_4C eutectic. In the ternary system iron-chromium-carbon the quasi-binary section Cr_7C_3 - Fe_3C is apparently valid.—B. Bl.

The Joule Magnetostrictive Effect in a Series of Cobalt-Iron Rods. S. R. Williams (*Phys. Rev.*, 1932, [ii], 40, 120).—Abstract of a paper read before the American Physical Society. The magnetostrictive oscillators of Pierce (this *J.*, 1929, 41, 430-431) have brought out the fact that the phenomena of magnetostriction may still have some practical significance, even if Arstall's (*Phil. Mag.*, 1847, 30, 76) idea of a reciprocating engine, based on the come and go of a rod changing its length in a varying magnetic field, did not materialize. In some measure the value of the magnetostrictive oscillators depends on the magnitude of the Joule effect. A series of cobalt-iron rods has been studied in order to see how the static magnetostrictive Joule effect varies with increasing amounts of cobalt in a series of cobalt-iron alloys. Later the dynamic magnetostrictive effects will be studied and compared with the static effects. This study shows that cobalt-iron alloys have a very much larger magnetostrictive effect than nickel.—S. G.

Thermal Expansion of Copper Alloys. Peter Hidnert (*Phys. Rev.*, 1932, [ii], 39, 551).—Abstract of a paper read before the American Physical Society. The linear thermal expansion of two cast copper alloys was investigated. One alloy contained copper 84.84, tin 14.95, and lead 0.21%, and the other contained copper 85.0, tin 5, zinc 5.1, and lead 4.9%. The coeff. of expansion obtained from the observations on heating are set out in the form of a table. The results indicate that the substitution of about 5% zinc and 5% lead for 10% tin in the first alloy caused slight if any changes in the coeff. of expansion.—S. G.

On the Internal Stress in Cold-Rolled Plates of Various Kinds of Metals [Copper and its Alloys, Iron, Steel]. Kisuke Saitô (*Kinzoku no Kenkyu*, 1932, 9, (5), 207-217).—[In Japanese.] The magnitude of internal stress and its distribution in cold-rolled plates of various metals were measured by Heyn's method. Six metals and alloys were selected for the investigation: Armeo iron, 0.5% carbon steel, 70:30 brass, 60:40 brass, copper, and bronze containing 6% of tin. The results showed that the stress is distributed in the following manner: the compressive stress is maintained in both sides of the plate, its magnitude being greatest at the edge of the plate, and the middle part of it is subjected to tensile stress. The maximum magnitude of internal stress in the case of iron and steel is greater than that of the stress in copper and its alloys.—S. G.

Aluminium-Bronze. Anon. (*Metallurgist* (Suppt. to *Engineer*), 1932, 8, 102-103).—A brief review of the properties of the alloys, referring in particular to an article by M. G. H. Meigh in *Rev. Mét.*, 1932, 29, 208-214. See *J.*, this volume, p. 602.—R. G.

Researches on the Copper-Beryllium System. Heinz Borchers (*Abhandl. Inst. Metallhütt. u. Elektromet. Tech. Hochschule, Aachen*, 1932, [N.F.], 1, 6 pp.).—Reprinted from *Metallwirtschaft*, 1932, 11, 317-321, 329-330. See *J.*, this volume, p. 602.—A. R. P.

The Copper-Beryllium Alloys. Heinz Borchers (*Metallurgist* (Suppt. to *Engineer*), 1932, 8, 152-154).—A summary of a paper by B. in *Metallwirtschaft*, 1932, 11, 317-321, 329-330. See *J.*, this volume, p. 602, and preceding abstract.—R. G.

Some Results Obtained by the Method of Cementation on Pairs of Metals: Cu-Be, Cu-Si, Ag-Be, Ag-Si, Au-Si. L. Loskiewicz (*Technique moderne*, 1930, 22, 732).—Abstract of a paper read at the 6e Congrès International des Mines, de la Métallurgie et de la Géologie Appliquée. See this *J.*, 1931, 47, 516.

—H. W. G. H.

The Equilibrium Diagram of the Copper-Gold Alloys. G. Grube, G. Schönmann, F. Vaupel, and W. Weber (*Z. anorg. Chem.*, 1931, 201, 41-74).—The transformation temperatures of copper-gold alloys have been determined by measurements of the electrical resistance and thermal expansion at 20°-460° C. of alloys with 17-85% gold. Three new phases are produced by

decomposition of the α -solid solution: β up to 34% gold, γ from 38 to 62% gold, and δ above 64.5% gold. Between β and γ and between γ and δ are regions of heterogeneity in which the surrounding phases are in equilibrium. The β solid solution is characterized by an oriented distribution of the Au_3Cu compound, and the γ -solid solution by that of the AuCu compound. On heating, the transformation of the β - and γ -phases takes place in two stages, in the first of which a disturbance occurs in the regular atomic distribution, and in the second the still partly oriented arrangement becomes completely converted into the random distribution of the solid solution phase stable at high temperature. Micrographic examination confirms the above results.—B. Bl.

Investigations on the Transformations in the Solid State in the System Copper-Gold. M. Le Blanc and G. Wehner (*Ann. Physik*, 1932, [v], 14, 481-509).—Copper-gold alloys were annealed at different temperatures for a period, in some cases about a week, such that the heating and cooling curves of electrical resistance coincided. The thermoelectric power was then determined and photomicrographs and röntgenographs were prepared. Besides the known compounds AuCu and Au_3Cu , a new compound, Au_2Cu_3 , stable below 400° C. has been discovered by maxima in the electrical conductivity and thermoelectric power curves; the lattice structure of this compound is the same as that of CuAu . At 250° C. all the compounds undergo a transformation not detectable by X-rays. Whether two-phase fields exist between the compounds or not could not be established.—v. G.

The Constitution of the Liquid and Solid Alloys of the Copper-Gold System Examined Thermodynamically. F. H. Jeffery (*Trans. Faraday Soc.*, 1932, 28, 455-457).—Thermodynamic calculations indicate that the liquid and solid solutions in the copper-gold system are derived from monatomic molecules of copper and gold.—A. R. P.

The Constitution of the Copper-Silver Series of Alloys Examined Thermodynamically. F. H. Jeffery (*Trans. Faraday Soc.*, 1932, 28, 705-707).—Thermodynamic considerations show that the liquid alloys and the two solid solutions consist of monatomic molecules of silver and copper.—A. R. P.

Hard Copper Alloys of High Quality. K. Ewig-Daues (*Z. Metallkunde*, 1932, 24, 214-219; discussion, 219-220).—Read before the Deutsche Gesellschaft für Metallkunde. The methods leading to perfection in the manufacture and working of high-quality tin-bronzes, "aluminium-bronzes," and special brasses are discussed, and the constitution, melting, deoxidation, casting, heat-treatment, rolling, &c., are considered.—M. H.

Volume Changes by Diffusion in Connection with Inverse Segregation on Rapid Solidification. C. Haase (*Z. Metallkunde*, 1932, 24, 258-261).—Chill-cast zinc-copper alloys with 10, 15, and 23% copper show inverse segregation. On annealing at temperatures near the solidus a considerable increase in volume occurs accompanied by a gradual compensation of the differences of concentration. This anomalous increase in volume is very probably due to a directed diffusion which results in a growing of the primary dendritic crystallites and the formation of hollow spaces. An explanation of the phenomenon of inverse segregation is suggested based on these results.—M. H.

The Beta to Alpha Transformation in Hot-Forged Brass. Robert S. Baker (*Amer. Inst. Min. Met. Eng., Preprint*, 1931, Sept., 1-4).—The transformation from β directly to α in 61-62.5% brass, which has been examined in the laboratory by Phillips, is now examined under conditions which occur during the hot-working of brass. A rod having the composition copper 60.26, zinc 37.86, and lead 1.88% was used for forging. The possibility that the lead might obstruct or accelerate the precipitation of α -brass was not studied. The rod was heated to 800° C. before forging. The rim of the original forging in which the transformation was noted was imperfectly formed. The natural flow of the metal into the die had been arrested and the presence of the trans-

formed α gave a clue to what had occurred. Corrective measures were devised and applied.—W. A. C. N.

On the Tensile Properties of β -Brass. U. Dehlinger and F. Mendl (*Metallwirtschaft*, 1932, 11, 424).—The elongation of β -brass is increased slightly by prolonged annealing at 430° C., probably owing to a rearrangement of the atoms.—v. G.

Factors Affecting the Physical Properties of Cast Red Brass (85 Cu, 5 Zn, 5 Sn, 5 Pb). H. B. Gardner and C. M. Seager, Jr. (*Met. Ind. (Lond.)*, 1932, 41, 181-183, 199-200; and *Metallurgist (Suppt. to Engineer)*, 1932, 8, 156-157).—Abstract of a paper read before the American Society for Testing Materials. See *J.*, this volume, p. 427.—J. H. W.

Magnetic and Mechanical Hardness of Dispersion-Hardened Iron Alloys. K. S. Seljesater and B. A. Rogers (*Trans. Amer. Soc. Steel Treat.*, 1931-32, 19, 553-572; discussion, 572-576; and *Bell Telephone System Tech. Publ.*, B-670, 1932, 1-20).—The effect of dispersion- or age-hardening on the magnetic properties of a number of carbon-free binary, ternary, and quaternary iron alloys has been investigated. Binary alloys of iron with tungsten, molybdenum, beryllium, and titanium all exhibit a marked increase in coercive force, accompanied by a rise in residual magnetism, as the temperature of the ageing treatment is raised. In some cases the increase in coercive force occurs simultaneously with the rise in hardness value, whilst in others, notably the iron-titanium alloys, the magnetic properties do not change appreciably until the hardness readings have gained considerably, or even reached their maximum value. Both hardness and coercive force pass through maximum values. The binary alloy containing 23.4% molybdenum attained a coercive force of more than 200 gilberts per cm. Among the ternary group, the iron-tungsten-cobalt combination is of greatest interest. Unlike magnet steels, these alloys do not attain maximum mechanical and maximum magnetic hardness under the same treatment, but experience a minimum of coercive force as the hardness passes through a maximum value.—S. G.

The Resistance of Lead Base Antifriction Metals. Anon. (*Fonderie mod.*, 1932, 26, 247).—Taken from *Z. ges. Giesserei Praxis: Das Metall*, 1931, 52, 123-124. See *J.*, this volume, p. 153.—J. H. W.

Gittermetall [a New Bearing Metal]. Carl Krömer (*Maschinenkonstrukteur*, 1931, 64, 160).—A bearing alloy containing added graphite is described and illustrated. It is claimed that the graphite, whilst uniformly distributed through the alloy, quickly provides a smooth bearing surface, and thus saves wear and lubrication and ensures smooth running. Comparative curves are given showing wear and rise in bearing temperature for Gittermetall and some standard bearing alloys.—P. M. C. R.

Recent Applications of the B.N.F. [M.R.A.] Ternary Alloys of Lead. Kenneth Gray (*Junior Inst. Eng., J. and R. Trans.*, 1932, 42, 517-528; and (abstract) *Met. Ind. (Lond.)*, 1932, 40, 395-397, 427-428).—Based on Development Report No. D.3 of the British Non-Ferrous Metals Research Association. The characteristic type of cracking found in lead cable sheathing is traced to intercrystalline failure due to vibration fatigue, and is found to be identical in character with failures produced artificially in the Haigh machine. An exhaustive investigation of the physical, mechanical, and anti-corrosive properties of lead and its alloys showed that two series of alloys possessed an exceptionally promising range of qualities. Alloys recommended for commercial use are: (1) lead 99.25, cadmium 0.25, antimony 0.5%; (2) lead 98.25, cadmium 0.25, tin 1.5%. Their tensile strengths were about 60% above that of lead, the elongation respectively 26% and 29% less, the Brinell hardnesses 100% and 90% higher, the Haigh fatigue limit four times and three times as great, and the corrosion-resistances are practically unimpaired, and for some media are higher for No. 2 than for lead. The strengthening effect of

small proportions of cadmium is emphasized. The comparatively fine and even grain of the alloys tends to give uniformity of structure and of mechanical properties, and so to obviate to a great extent local failures due to excessive grain-growth (see also F. L. Brady, *J.*, this volume, p. 300). Freezing tests are described, and future lines of investigation are indicated.

—P. M. C. R.

Investigations on Binary Solid Solutions of Magnesium. I.—Röntgenographic Determination of the Boundary of the α -Solid Solution Range of Aluminium-Magnesium and Zinc-Magnesium Alloys. II.—Tensile Tests on Homogenized Aluminium-Magnesium and Zinc-Magnesium Solid Solutions. E. Schmid and H. Seliger (*Metallwirtschaft*, 1932, 11, 409-411, 421-424).—(I.)—Cf. *J.*, this volume, p. 2. The solid solubility of zinc in magnesium falls from 8.41% at the eutectic temperature (344° C.) to 3.29% at 250° C. and 1.71% at 150° C. The corresponding values for aluminium in magnesium have already been published (this *J.*, 1932, 48, 226). (II.)—Single crystals of magnesium containing zinc or aluminium in solid solution deform in the tensile test like pure magnesium by slip along the basal plane in the direction of a diagonal axis of the first type. The shear stress at the elastic limit rises from 83 grm./mm.² for pure magnesium to 1300 grm./mm.² for the 9.7% aluminium alloy and to 725 grm./mm.² for the 5% zinc alloy. The maximum shear strength reached during the tensile test passes through a maximum with the 4% aluminium and with the 1% zinc alloy, and then decreases with higher quantities of alloying element; the total energy of deformation absorbed by the crystal follows a similar course.—v. G.

On the Elongation of Ternary Magnesium Solid Solutions. E. Schmid and G. Siebel (*Metallwirtschaft*, 1932, 11, 577-579).—Single crystals of magnesium with up to 5.6% aluminium and up to 1% zinc show in the tensile test geometrically the same deformation process as pure magnesium crystals and crystals of binary magnesium alloys. The yield-point compared with that of pure magnesium is raised as though both additions acted additively, but the increase in the tensile curve is less than the sum of the strengthening actions of the individual constituents.—v. G.

Thermal and Electrical Conductivity and the Behaviour of a Number of Magnesium Alloys with Regard to the Wiedemann-Franz Law. Rimpei Kikuchi (*Kinzoku no Kenkyu*, 1932, 9, (6), 239-243).—[In Japanese.] According to the method of Kohlrausch, corrected by Sinizu and Masumoto, the author measures thermal conductivity (λ), the electrical conductivity (κ), and the quotient λ/κ , according to the Wiedemann-Franz law, with respect to magnesium alloys and certain others. He further investigates the variations of the foregoing three values for some binary magnesium alloys containing certain proportions of aluminium, silver, copper, nickel, tin, or zinc. The results may be summarized as follows: with the binary alloys the two conductivities vary in the same sense, but the Wiedemann-Franz quotient does not remain constant with increasing additions of alloying metal.—P. M. C. R.

On Elektron. M. M. Hrustchov (*Tehnika Vostushnogo Flota (Technology of the Aerial Navy)*, 1930, (4), 253-260).—[In Russian.] A brief description, based on published data, of the best-known Elektron alloys, their mechanical properties, methods of melting, pouring, and casting.—N. A.

Alloys of Iron, Manganese, and Carbon. I.—Preparation of Alloys. Francis M. Walters, Jr. (*Trans. Amer. Soc. Steel Treat.*, 1931-32, 19, 577-589).—See *J.*, this volume, p. 78.—S. G.

Alloys of Iron, Manganese, and Carbon. II.—Thermal Analysis of the Binary Alloys. Francis M. Walters, Jr., and Cyril Wells (*Trans. Amer. Soc. Steel Treat.*, 1931-32, 19, 590-598).—See *J.*, this volume, p. 78.—S. G.

Alloys of Iron, Manganese, and Carbon. III.—An X-Ray Study of the Binary Iron-Manganese Alloys. M. Gensamer, John F. Eckel, and F. M.

Walters, Jr. (*Trans. Amer. Soc. Steel Treat.*, 1931-32, 19, 599-607).—See *J.*, this volume, p. 79.—S. G.

Alloys of Iron, Manganese, and Carbon. IV.—A Dilatometric Study of Iron-Manganese Binary Alloys. Francis M. Walters, Jr., and M. Gensamer (*Trans. Amer. Soc. Steel Treat.*, 1931-32, 19, 608-621; discussion, 621-623).—See *J.*, this volume, p. 79.—S. G.

The Electrical Conductivities of Liquid Alkali-Metal Amalgams. D. Boohariwalla, G. R. Paranjpe, and Mata Prasad (*Indian J. Physics*, 1929, 4, 147-159; *C. Abs.*, 1930, 24, 9).—Electrical conductivities were measured by the potentiometric method for liquid sodium, potassium, and lithium amalgams with a capillary cell calibrated with mercury. The conductivity-concentration curves showed breaks agreeing with work by others. From the resistance-temperature curve and also conductivity measurements with d.c. and a.c. it is concluded that conduction is metallic.—S. G.

Ferromagnetism of the Alloys of Nickel and Chromium. Ch. Sadron (*Compt. rend.*, 1930, 190, 1339-1340; *C. Abs.*, 1930, 24, 4748).—The saturation value of the intensity of magnetization was determined for 4 nickel-chromium alloys containing 1.51, 2.92, 6.02, and 8.00% chromium, at 10° intervals in the range 110°-150° K. By extrapolation the corresponding values of the saturation at 0° K. were obtained as 50.9, 43.7, 29.0, and 21.9 based on Weiss and Forrer's value of 57.87 for pure nickel. The first three values decrease linearly with increase of chromium, but the value for the 8% alloy is considerably larger than that indicated by the simple linear law. The ferromagnetic Curie points were found to be 504° K. for the 2.92% alloy, 347° K. for the 6.02% alloy, 270° K. for the 8.00% alloy, and 130° K. for a 10% alloy. By plotting these values and extrapolating, S. concludes that an alloy containing about 12% chromium would have its Curie point at 0° K. with a magnetic moment of zero.—S. G.

Magnetic Alloys. T. D. Yensen (*Metallurgist (Suppt. to Engineer)*, 1932, 8, 105-106).—A summary of an article by Y. in *Metal Progress*, 1932, 21, (6), 28-34, 70. See *J.*, this volume, p. 605.—R. G.

Permeability of Hipernik Reaches 167,000. T. D. Yensen (*Elect. J.*, 1931, 28, 286-288; *C. Abs.*, 1931, 25, 3921).—Hipernik is a refined iron-nickel alloy made by removing small amounts of impurities, chiefly oxygen, from the 40-60% alloy. A difference in the amount of aggregate impurities of a few hundredths makes a difference in magnetic properties of several hundred %. Curves compare Hipernik with 4% silicon iron. A maximum permeability of 167,000 was obtained with a lot of Hipernik, the base of which was manufactured in a commercial steel plant and the punchings from which were annealed in a commercial type of furnace. Hipernik is being used in increasing quantities as cores for instrument transformers. The high permeability and the low loss reduce the ratio errors and phase angle deviations to negligible quantities.—S. G.

On Changes of Phase in Iron-Nickel Alloys which are Capable of Supercooling. (The High Permeability of Air-Cooled Permalloy.) O. Dahl (*Z. Metallkunde*, 1932, 24, 107-111).—Earlier investigations of the structural cause of the magnetic properties of Permalloy (iron 78.5, nickel 21.5%) are discussed. In order to throw further light on the nature of these transformations the percentage change of the electrical resistance and hardness of alloys with 50-92% nickel was determined on annealing at temperatures between 200° and 950° C. after water-quenching at 950° C. or slow cooling from 950° C. The changes are analogous to those which are observed with the disintegration of supersaturated solid solutions on annealing. It is concluded that after quenching the alloys exist as a solid solution, and that on slow cooling (below 600° C.) a decomposition of the solid solution takes place which is due to the formation of the compounds FeNi₃ and possibly FeNi₂. The magnitude of the changes is considerably

influenced by manganese and silicon. The behaviour of Perminvar is shown to be similar.—M. H.

Faults in the Manufacture of Silver Sheet. E. Raub (*Mitt. Forschungsinst. Edelmetalle*, 1931, 5, 71-77).—Reprinted from *Metallwirtschaft*, 1931, 10, 769. See *J.*, this volume, p. 21.—A. R. P.

On the Improvement of Standard Silver. Max Haas and Denzo Uno (*Abhandl. Inst. Metallhütt. u. Elektromet. Tech. Hochschule, Aachen*, 1932, [N.F.], 1, 3 pp.).—Reprinted from *Z. Metallkunde*, 1929, 21, 94-96. See this *J.*, 1929, 41, 463.—A. R. P.

On the Solubility of Silver in Copper. F. Möller (*Abhandl. Inst. Metallhütt. u. Elektromet. Tech. Hochschule, Aachen*, 1932, [N.F.], 1, 7 pp.).—Reprinted from *Metallwirtschaft*, 1930, 9, 879-885. See this *J.*, 1931, 47, 78.—A. R. P.

The Ternary System Silver-Copper-Phosphorus. H. Moser, K. W. Fröhlich, and E. Raub (*Z. anorg. Chem.*, 1932, 208, 225-237).—The solubility of phosphorus in copper is 0.160% at 900° C. and 0.122% at 660° C. Copper-phosphorus alloys with up to 40-50% phosphorus can be prepared by the action of phosphorus vapour on copper powder; between 14 and 26% phosphorus the alloys are homogeneous. Silver and AgP_2 form a eutectic at 0.98% phosphorus and 878° C. At 960° C. about 1.45% phosphorus is soluble in liquid silver; with more phosphorus two liquid phases co-exist. The surfaces of primary, secondary, and tertiary crystallization in the system silver-copper- Cu_3P have been determined by thermal investigation of sections of constant copper, silver, and Cu_3P content. The constitution of the system is very simple, since the three limiting binary systems are of the simple eutectic type. The silver- Cu_3P eutectic lies at 53.8% Cu_3P , and 797° C. and the ternary eutectic at 17.9% silver, 30.4% copper, 51.7% Cu_3P , and 646° C. Microscopic investigation of the system silver- Cu_3P - AgP_2 reveals a ternary eutectic at 44.9% silver, 41.6% Cu_3P , 13.4% AgP_2 , and 703° C.

—M. H.

Tests on Tin-Base and Lead-Base Bearing Metals. C. Jakeman and Guy Barr (*Brit. N.-F. Metals Res. Assoc., Res. Rep., Assoc. Series*, No. 289A, 1931, 1-23; and (abridged) *Engineering*, 1932, 133, 200-202).—Comparative tests were carried out, in a journal friction-testing machine with fully lubricated bearings, on lead-base, tin-base, and alkali metal-lead bearing alloys. The testing machine, method of testing, control, and measurement of temperature, and types of oil used, are fully described. Results show that though the alkali metal-lead alloy runs satisfactorily with low or moderate loads it does not do so with high loads or at increased temperatures. It runs well with mineral or compounded oils, but is freely attacked by sperm or mineral oils. Common lubricants do not readily attack either high-lead or high-tin bearing alloys, but the former shows in most instances the higher loss through friction.—P. M. C. R.

Bearing Properties Affected by Variations in Composition. Clair Uptegrove (*Foundry*, 1931, 59, 72-74).—Report of a paper read at a meeting of the American Society for Testing Materials held in Detroit. Specification No. 11 for tin-base Babbitt metal, recommended by the American Society of Automotive Engineers, admits of certain variations in the tin, copper, and antimony contents. The effects of these on structure are summarized in a constitutional diagram, and are discussed in the text, with certain modifications in casting methods for use in special cases. The casting, structure, and mechanical properties of the bearing bronzes are considered, together with the effect of nickel on their strength and their behaviour under lubrication. A short review is given of the possibilities of light metal-base alloys.—P. R.

Investigation of Hard Alloys Used in Drilling. N. F. Pravdiuk and S. J. Schistchenko (*Azerbaigianskoe Neftjanoe Khoziastvo (Oil Economy of Azerbaidjan)*, 1930, (2), 51-69).—[In Russian.] The hardness, resistance to erosion, microstructure, and chemical analysis of many hard alloys (chiefly

those with a chromium or tungsten base) used in drilling operations in the Baku petroleum industry have been examined, with a view to study the problem of their production in the U.S.S.R.—D. N. S.

On the Production of Hard Alloys for Drilling. N. Pravdiuk and W. Negreev (*Azerbaigeanoskoe Neftjanoe Khoziastvo (Oil Economy of Azerbaidjan)*, 1930, (12), 99–113).—[In Russian.] Successful experiments on the production of the American tungsten alloy "Blackor" used in drilling for petroleum have been made. A new alloy, named "Dognat," has been prepared, differing from "Blackor" in that ferro-tungsten is used instead of pure tungsten, thus greatly cheapening manufacture. It was found that the new alloy was not inferior to "Blackor" under working conditions.—D. N. S.

The Properties of Certain Alloys Employed in Drilling. N. Pravdiuk and W. Negreev (*Azerbaigeanoskoe Neftjanoe Khoziastvo (Oil Economy of Azerbaidjan)*, 1931, (9–10), 63–69).—[In Russian.] Results of tests on the hardness and resistance to erosion of 12 hard alloys with a ferro-tungsten and ferro-chromium base, both of Russian and foreign make, showed that certain of the Russian alloys, e.g. "Dognat" alloy, are not inferior to the foreign.—D. N. S.

The System Iron-Carbon-Vanadium. H. Hougardy (*Mitt. Forsch.-Inst. Ver. Stahlwerke A.G. Dortmund*, 1930, 2, 39–60; also *Arch. Eisenhüttenwesen*, 1931, 4, 497–503; and *Stahl u. Eisen*, 1931, 51, 592–593; *Brit. Chem. Abs.*, 1931, [B], 808).—In the iron-vanadium system the γ -field extends to 1.1% vanadium, but the addition of carbon to the alloys extends the γ -range in such a way that the maximum amount of vanadium in the γ -phase is given by the equation $V = C/0.175 + 1.1$; this implies that the additional vanadium is present as V_4C_3 , and that the system is pseudo-binary. V_4C_3 does not form a double carbide with Fe_3C , both being precipitated independently when sufficient carbon is present, and forms no solid solutions with α - or δ -iron, but a limited series of solid solutions with γ -iron. The A1 point of the iron-carbon system occurs at 10° C. above the normal temperature in the presence of vanadium, independent of the amount present, provided that the alloy contains cementite or pearlite. The hardness of quenched ternary alloys ceases to increase above a definite vanadium content dependent on the carbon present, and these alloys have a lustrous, coarsely crystalline fracture which cannot be changed by heat-treatment; their microstructure shows the presence of V_4C_3 and ferrite only.—S. G.

The Alloys of Iron, Vanadium, and Carbon. Anon. (*Metallurgist (Suppt. to Engineer)*, 1931, 7, 91–94).—A summary and critical discussion of two recent papers on the subject by R. Vogel and E. Martin (*J.*, this volume, p. 606) and by H. Hougardy (preceding abstract).—R. G.

Division of the Iron-Vanadium-Oxygen System into Some of its Constituent Binary and Ternary Systems. C. H. Mathewson, E. Spire, and C. H. Samans (*Trans. Amer. Soc. Steel Treat.*, 1932, 20, 357–384).—Four oxide phases are revealed by X-ray analysis of briquetted and sintered mixtures prepared *in vacuo* as capable of existing separately in equilibrium with iron. These are FeO (a solid solution), FeV_2O_4 , V_2O_3 , and V_2O_2 . The last, which reduces ferrous oxide, was the lowest oxide of vanadium observed, and certain acicular structures, representing the separation of vanadium from solid solution in V_2O_2 , are illustrated. The metallographic investigation of the eutectic system $FeO-FeV_2O_4$ is discussed, and the iron corner of the constitutional diagram is analysed into the systems $Fe-V-V_2O_2$, $Fe-V_2O_2-V_2O_3$, $Fe-V_2O_3-FeV_2O_4$, and $Fe-FeV_2O_4-FeO$. Tables of X-ray data, and several photomicrographs are appended.—P. M. C. R.

Relation of Crystal Orientation to Bending Qualities of a Rolled Zinc Alloy. Gerald Edmunds and M. L. Fuller (*Amer. Inst. Min. Eng. Preprint*, 1931, Sept., 1–11).—A study of the variations in orientation on the cross-section of rolled strips and their influence on the anisotropic characteristics of worked metals. A rolled zinc alloy was used for the investigation. It

has been found that good and poor bending metals frequently show no significant differences according to the ordinary physical tests such as hardness, ductility, and tensile tests, but when critically examined for preferred orientations invariably reveal dissimilarity. The dynamic cold-bend test was used to determine bending quality. X-ray examination was undertaken and Wever pole figures have been constructed. Two types of orientation are unfavourable for bending deformations, viz. basal planes: (1) parallel to, or (2) perpendicular to, a line normal to the axis of the bend and lying in the surface of the strip. The first type has been found as a thin layer at the surface of rolled zinc alloy strips. These had poor bending qualities whenever the orientation persisted to a depth of 0.0005 in. or more. The cause of better cross-grain than with-grain bending properties has been determined.—W. A. C. N.

Silicon as an Alloying Element. John Arnott (*Proc. Inst. Brit. Found.*, 1930-31, 24, 140-147; discussion, 147-150).—See this *J.*, 1931, 47, 431.

—S. G.

On the Boiling Temperatures of Some Metals and Alloys at Atmospheric Pressure. W. Leitgeb (*Z. anorg. Chem.*, 1931, 202, 305-324).—The boiling points of the following metals have been determined in a high-frequency furnace by means of a platinum/platinum-rhodium thermocouple: cadmium $767 \pm 2^\circ\text{C}$., zinc $907 \pm 2^\circ\text{C}$., magnesium $1097 \pm 3^\circ\text{C}$., thallium $1457 \pm 10^\circ\text{C}$., bismuth $1560 \pm 5^\circ\text{C}$., antimony $1635 \pm 8^\circ\text{C}$., and lead $1740 \pm 10^\circ\text{C}$. The theory that the curves obtained by plotting the logarithm of the vapour pressure against the reciprocal of the absolute temperature tend to a limiting value of 4.6 can be used to confirm the experimental data except in the case of antimony. The boiling-point curves have been determined for the following systems: aluminium-magnesium, aluminium-zinc, bismuth-lead, bismuth-antimony, cadmium-lead, cadmium-magnesium, cadmium-zinc, copper-zinc, magnesium-lead, magnesium-antimony, magnesium-zinc, lead-antimony, lead-thallium, lead-zinc, and antimony-zinc. The curves for bismuth-antimony and lead-antimony have a maximum. In all the above systems the elevation of the boiling point of a metal by addition of another metal is greater the lower the atomic weight of the second metal. The boiling-point surface of the ternary system cadmium-zinc-lead at atmospheric pressure rises slowly and regularly from the binary system cadmium-zinc to about 70% lead, then rises sharply and steeply to the boiling point of lead.—B. Bl.

On the Problem of Precipitation-[Age]-Hardening. Otto Feussner (*Metallwirtschaft*, 1932, 11, 450-451).—The hypothesis that in age-hardening phenomena the diffusion of the added element and crystal recovery have opposing effects is discussed with reference to the properties of palladium-hydrogen alloys.—v. G.

Investigations of the Hardening of Non-Ferrous Metal Alloys. Denzo Uno (*Abhandl. Inst. Metallhütt. u. Elektromet. Tech. Hochschule, Aachen*, 1932, [N.F.], 1, 9 pp.).—Dissertation, Aachen, 1929. Cf. this *J.*, 1931, 47, 527.

—A. R. P.

Dissolved Gas in Metals and Alloys. L. Guillet and A. Roux (*Usine*, 1931, 40, (2), 31).—Abstract of paper read at the Congrès International de Sécurité Aérienne, December 1930. Results of annealing and melting *in vacuo* of steel, brass, aluminium, Duralumin, and copper, lead the authors to consider that the deleterious effect of gas on the mechanical properties is not as great as has often been supposed.—H. W. G. H.

New Alloys. Anon. (*Metallurgist* (Suppt. to *Engineer*), 1932, 8, 114-115).—A discussion of the factors which have contributed to progress in the evolution of new metallurgical products.—R. G.

The Chemistry of Alloys. A. Westgren (*Light Metals Research*, 1932, 2, (6), 2-17).—Translated in full from *Angew. Chem.*, 1932, 45, 33. See *J.*, this volume, pp. 352, 552.—J. C. C.

Interatomic Forces in Binary Alloys. Quantitative Determination from Thermodynamic Data. Nelson W. Taylor (*J. Amer. Chem. Soc.*, 1931, 53, 2421-2423; *C. Abs.*, 1931, 25, 3882).—A preliminary paper in which Langmuir's equation for the deviation of activities from Raoult's law in binary liquid mixtures is applied to a number of liquid alloys (zinc-cadmium, cadmium-lead, cadmium-tin, thallium-tin, zinc-tin); for all systems except zinc-tin (which is certainly abnormal) the agreement is good to 3%. More extensive data will be presented later.—S. G.

Properties of Non-Ferrous Alloys at Elevated Temperatures. C. L. Clark and A. E. White (*Met. Ind. (Lond.)*, 1930, 37, 601-604, and 1931, 38, 15-16).—Abstract of a paper contributed by the Joint Research Committee on Effect of Temperature on the Properties of Metals at the American Society of Mechanical Engineers. See *J.*, this volume, p. 159.—J. H. W.

Some Considerations and Tests for Cast Materials for High-Temperature, High-Pressure Service. L. W. Spring (*Proc. Inst. Brit. Found.*, 1930-31, 24, 239-289).—American exchange paper. See this *J.*, 1931, 47, 527.—S. G.

Some Non-Ferrous Engineering Alloys. Wesley Lambert (*South African Eng.*, 1931, 42, 57-59; 86-88).—A paper read before the Institution of Engineers and Shipbuilders in Scotland. See this *J.*, 1931, 47, 15-16.—P. R.

The Variations in Hardness of Certain Metals and Alloys with Hammering. — Guichard, — Clausmann, and — Billon (*Technique moderne*, 1930, 22, 732).—Abstract of paper read at the 6e Congrès International des Mines de la Métallurgie et de la Géologie Appliquée. See this *J.*, 1930, 43, 427.—H. H.

Influence of Initial Condition of Certain Metals and Alloys on the Variations in Hardening by Hammering. — Guichard, — Clausmann, and — Billon (*Technique moderne*, 1930, 22, 732).—Abstract of paper read before the 6e Congrès International des Mines de la Métallurgie et de la Géologie Appliquée. See this *J.*, 1930, 43, 487.—H. W. G. H.

Internal Stresses Existing in Solids in the Absence of External Forces. J. Seigle (*Rev. Ind. Minérale*, 1930, (222), 111-134; (223), 149-155; *Eng. Index*, 1930).—Deals with modes of treating these mechanical and thermal stresses and examples of their effects; the influence of internal stresses in iron and steel pipe subjected to internal pressure; evidences of internal forces; deformations and cracks; the action of certain liquids; and the suppression and attenuation of internal forces.—S. G.

III.—CORROSION AND PROTECTION

(Continued from pp. 666-670.)

CORROSION.

Present-Day Testing of Fuels for Aviation. [Corrosion by Liquid Fuels.] Alexander v. Philippovich (*Z. Flug. u. Motor.*, 1931, 22, 80-84).—Section on Corrosion, p. 81: Corrosion due to fuel is mainly traceable to the presence of water, although occasional impurities, such as pyridine, may cause severe attack. Sulphur corrosion is mainly due to free sulphur, and increases in proportion with the conductivity of the fuel. The influence of sulphur compounds cannot be exactly estimated owing to their varying reactions in different fuels. Ordinary fuels scarcely affect aluminium, but some attack is observed on the addition of alcohol or if the water content is increased.—P. M. C. R.

Corrosion Due to Differences of Potential and its Prevention. Erich K. O. Schmidt (*Z. Flug. u. Motor.*, 1931, 22, 177-178).—Corrosion is frequently set up when brass fittings are screwed into aero parts made of light alloys. Those examined were Silumin and two varieties of Elektron. Corrosion was almost

completely obviated by the use of a screw-socket of a non-conducting material such as Bakelite or Harex, the latter giving slightly better results.—P. R.

The Alteration in Mechanical Properties of Duralumin Sheet after Corrosion by Sea-Water. E. Herzog and G. Chaudron (*Technique moderne*, 1930, 22, 295).—Abstract of a note presented to the Académie des Sciences. See this *J.*, 1930, 43, 494.—H. W. G. H.

Investigations on Stress-Corrosion Cracks of Light Metals. P. Brenner (*Z. Metallkunde*, 1932, 24, 145-151).—The conditions under which cracks occur during corrosion of light metals internally stressed by cold-work (drawing bending, riveting, &c.) have been investigated. Several cases of such cracks in Lantal, Duralumin, and Elektron metal are illustrated and discussed. Age-hardened Duralumin and Lantal sheet (1 mm.) have been subjected to the salt-spray test for a period of 127 days under different elastic, plastic, and elastic + plastic deformations. Duralumin showed no tendency to crack; Lantal, however, showed numerous cracks and some pitting, a few samples breaking during the test. These differences in the behaviour of the alloys are attributed to the fact that even undeformed Lantal (age-hardened at elevated temperatures) tends to intercrystalline corrosion, whilst Duralumin (age-hardened at room temperature) does not.—M. H.

Investigations on the Corrosion of Duralplat Riveted Joints. Paul Brenner (*Z. Flug. u. Motor.*, 1931, 22, 344-346).—Results of comparative salt-water spray tests on 1.5 mm. Duralumin and Duralplat sheet are given; they are much in favour of the latter as regards both loss of weight and deterioration of mechanical properties. Riveted sheet of both materials, Duralumin being in both cases used for the rivet material, on comparative testing showed marked attack in the case of Duralumin, whilst the riveted Duralplat was almost unaffected. The action was most violent immediately beneath the rivet-heads, which were of the "round" type in the earlier part of the work. It was found that the use of countersunk Duralumin rivets obviated this form of attack.

—P. M. C. R.

Oxidation Processes of Copper and its Alloys in Liquids and their Electrochemical Behaviour. L. W. Haase (*Z. Metallkunde*, 1932, 24, 223-226; discussion, 226).—Copper and copper alloys can be oxidized in solutions of neutral salts by the dissolved oxygen to produce oxide films which are either highly protective against corrosion or quite ineffective; the nature of the film depends on the salt used and the conditions of the experiment.—M. H.

Explosion from the Main [Copper] Steam Pipe of the Steam Trawler "Elf King." Anon. (*Marine Eng. Officers' Mag.*, 1931, 12, 163-164).—A solid-drawn copper pipe, of 6 W.G. thickness, was blown out as the result of severe external corrosion. This was found to have been set up by a leakage of water from an adjacent gauge pipe, the contact of the moistened asbestos lagging with the copper having caused rapid attack on the latter.—P. M. C. R.

Aerated Water Plant for Use on Shipboard. A. A. Warden (*Marine Eng. Officers' Mag.*, 1932, 13, 389-396).—Modern aerating plant is described. On account of the corrosive action of water charged with carbon dioxide the copper "carbonator" or aeration vessel must be tinned on the internal surface; pure ingot tin is used for the solution piping, and all bolts employed must also be tinned.—P. M. C. R.

Contribution to the Corrosion of Brass. Max Haas (*Abhandl. Inst. Metallhütt. u. Elektromet. Tech. Hochschule, Aachen*, 1932, [N.F.], 1, 10 pp.).—Reprinted from *Korrosion u. Metallschutz*, 1929, 5, 25-35. See this *J.*, 1929, 41, 480.—A. R. P.

Condenser-Tube Corrosion. D. G. McNair (*Marine Eng. Officers' Mag.*, 1931, 12, 562-566).—Factors especially affecting marine corrosion are enumerated, and some important engineering and economic consequences are indicated. Materials for tubing are discussed, with special reference to Monel metal, and

prices compared. The introduction of aluminium-brass tubing may have beneficial results, but the variability of marine conditions necessitates prolonged and carefully recorded running tests before any material can be accepted as reliable.—P. M. C. R.

Modern Methods of Combating Corrosive Action. D. G. McNair (*Marine Eng. Officers' Mag.*, 1931, 12, 263-267).—The "acid" and "electrochemical" theories of corrosion are first considered. Corrosion in boilers, turbine blading, and condenser tubes is then discussed, and protective methods are enumerated in each case. In the two latter instances it is considered that the use of corrosion-resistant alloys gives under marine conditions the most efficient protection, and that this consideration justifies the expense of their installation.

—P. M. C. R.

Efficiency Effect of Erosion of Blades on a Radial Flow Turbine. Burnett F. Treat (*J. Amer. Soc. Naval Eng.*, 1929, 41, 444-450; and (abstract) *Mech. World*, 1929, 86, 383-385, 450).—The effects of actual erosion in wear were simulated in an experimental "radial-flow" turbine by making a series of surface cuts in the blading, of the type and in the position usually affected. Running tests were made with each series of cuts at various speeds and dynamometer loadings. At normal speed the steam consumption was scarcely affected, except by the deeper cuts; the $\frac{1}{16}$ -in. cut increased efficiency at all speeds, and some deeper cuts at the higher speeds. This is attributed, however, to the knife-sharpening of the blades. T. considers that during the normal life of a turbine, blade erosion has little effect on steam consumption.—P. M. C. R.

Valve Wear and its Prevention. — Wahl (*Maschinenkonstrukteur*, 1931, 64, 191-193).—Corrosion, erosion, and friction are recognized as the principal causes of wear. Examples of each are discussed and illustrated. Careful selection of materials and of protective coverings provides a partial solution in the first instance, better design in the second, and maximum cleanliness in operation and the use of specially hard materials in the third. For this purpose "Trib-metal" is recommended, as possessing great hardness, high thermal expansion, good resistance to corrosion, and retention of strength to above 500° C. A type of valve is described in which this material is used for packing rings and plates, and other parts exposed to corrosion or wear.—P. M. C. R.

On the Corrosion-Resistance of a New Dental Alloy "Chrogo U42." H. Choulant (*Z. Metallkunde*, 1932, 24, 263-264).—Determinations of the loss in weight of 17 dental alloys (including gold-silver-copper alloys of 16- to 22-carat, V2A-steel, nickel-chromium-iron alloys, Monel metal, nickel-brass, brass, &c.) in 1% hydrochloric acid and in 1% lactic acid containing 0.25% sodium chloride have shown that the alloy "Chrogo U42," which contains gold 39.8, copper 45.0, nickel 14, chromium 1.0, and platinum 0.2%, is practically equal to high-carat gold alloys and considerably superior to the base metal alloys.—M. H.

The Behaviour of Gold and its Alloys with Silver and Copper towards Nitric and Sulphuric Acids. G. Tammann and E. Brauns (*Z. anorg. Chem.*, 1931, 200, 209-231).—Gold is practically unattacked by sulphuric acid at 200° C. or lower, not more than 0.01 mg./dm.² being dissolved in 8 hrs.; at higher temperatures, however, there is considerable dissolution, but this is decreased if the acid is previously boiled. Nitric acid of d 1.3 does not appreciably dissolve gold at 20° or at 100° C., but acid of d 1.5 dissolves considerable quantities of gold at 20° C., although the rate of dissolution decreases with time of contact. Gold-silver alloys with 75 and 55 atomic-% gold lose in 4 hrs. only 0.04 and 0.01 mg. at 100° C., and 0.01 and 0.03 mg./dm.² at 150° C., respectively, in sulphuric acid which has been previously boiled. Gold-silver alloys with more than 50 atomic-% gold suffer no detectable loss in sulphuric acid at 150° C., but an alloy with 49 atomic-% gold is appreciably attacked. Similar results are obtained with nitric acid (d 1.3), hence the resistance limit is between 49

and 50 atomic-% gold. Blue spots of copper nitrate appear on the surface of gold-copper alloys with 48-49 atomic-% gold on heating at 90° C. in nitric acid, but the alloy with 50 atomic-% gold is inert, hence the resistance limit in this series is also 49-50 atomic-% gold. In silver-gold alloys at high temperatures new silver atoms are brought to the surface by place-exchange with the gold atoms, hence the greater loss in hot acids; thus in sulphuric acid, alloys with 75 and 50 atomic-% gold lose 0.35 and 0.74 mg./dm.² at 250° C. and 0.92 and 1.93 mg./dm.² at 350° C., respectively. These losses are proportional to the atomic-% of silver in the alloys.—B. Bl.

Corrosion of Binary Alloys of Magnesium (First Report). Hikozi Endô and Susumu Morioka (*Kinzoku no Kenkyu*, 1932, 9, (8), 328-351).—[In Japanese.] An attempt was made to discover the effect of an added metal on the corrosion of magnesium, and also to obtain non-corrodible magnesium alloys for aqueous solutions of simple salts and sea-water. Various binary alloys containing 1-8% of low melting-point metals, such as tin, bismuth, thallium, cadmium, lead, zinc, antimony, aluminium, and calcium, were prepared, and the specimens were subjected to the action of distilled water, 0.1*N*-sodium chloride solution, and sea-water, the loss in weight of the specimens being measured after 1 month's exposure. From the results obtained, it is found that the corrodibility of magnesium is intimately related to the position of the added element in the periodic table and its crystal lattice.—S. G.

Corrosion of Binary Alloys of Magnesium (Second Report). Hikozi Endô and Susumu Morioka (*Kinzoku no Kenkyu*, 1932, 9, (8), 352-366).—[In Japanese.] This report contains the results of salt-spray and intermittent immersion tests on the same magnesium alloys as were described in the previous report (see preceding abstract). The object of the investigation was to discover the relation of the resistivity to the metal added to the magnesium.—S. G.

Corrosion of Tin and its Alloys. C. L. Mantell (*Sheet Metal Ind.*, 1930, 3, 596, 741; 4, 168-170).—Read before the American Institute of Mining and Metallurgical Engineers. See this *J.*, 1929, 41, 483.—S. G.

The Influence of Foreign Metals on the Rate of Dissolution of Base Metals. G. Tammann and F. Neubert (*Z. anorg. Chem.*, 1931, 201, 225-244; and (translation) *Light Metals Research*, 1932, 2, (5), 2-20).—The volume (v) of hydrogen evolved in time t , during the dissolution of zinc and solid solution alloys of zinc with a more noble metal in 0.5*N*-hydrochloric acid is given by the expression $v = at + bt^2$, where the second term on the right takes into account the accelerating effect of local elements. The rate of dissolution increases linearly with t , and the constant b increases rapidly with the concentration of the more noble metal. In the action of acids on iron and aluminium, $v = bt^2$, the initial velocity of dissolution being small in both cases. The value of b is increased by addition of silver or zinc to aluminium, or by addition of gold to iron, and decreased exponentially by addition of silicon or tin. The rate of dissolution of aluminium in sodium hydroxide solution is independent of the time, but increases linearly with the silicon content. Addition of aluminium to zinc and of magnesium to aluminium retards dissolution in accordance with the theory of local elements. The rate of dissolution of zinc and iron in persulphate solutions is independent of the time; addition of silver or copper to zinc reduces the rate of dissolution slightly proportional to the quantity added. As in this reaction every persulphate ion which reaches the metal surface reacts with it, the rate of dissolution cannot be accelerated by local elements.—B. Bl.

Mutual Action Between Metallic Utensils and Diabetic Material. I.—Action of Potable Liquids on Metals; Corrosion. B. Bleyer and J. Schwaibold (*Biochem. Z.*, 1931, 230, 136-145; and (extract) *Aluminium Broadcast*, 1931, 3, (11), 24).—The action of water, tea, and coffee on the more common metals (aluminium, zinc, iron, nickel, tin, lead, copper, silver, brass) was followed by determinations of the amount of metal dissolved and by the change in reaction

of the liquid under investigation. The results are recorded in tables and curves.—S. G.

On the Relation Between Regular Distribution of the Atoms and the Resistance Limits. U. Dehlinger and F. Giesen (*Z. Metallkunde*, 1932, 24, 197–198).—The difference between the dissolution potentials of electrolytically deposited and cast brass cannot be evidence against the non-existence of a relationship between the regularity of the distribution of the atoms in the lattice and the existence of galvanic resistance limits. Röntgenographs of electrolytically deposited 60 : 40 brass show broad Debye-interferences which are due either to inhomogeneity or, more probably, to the extremely small grain-size of the deposit. Both factors would produce a decrease in the resistance to attack by chemical agents such that any differences in the regularity of the atomic distribution (if these exist at all) would be surpassed.—M. H.

The Distribution of Corrosion. S. C. Britton and U. R. Evans (*Trans. Electrochem. Soc.*, 1932, 61, 441–455).—See *J.*, this volume, p. 232, and following abstract.—S. G.

Discussion on S. C. Britton and U. R. Evans' Paper on "The Distribution of Corrosion." G. D. Bengough, A. R. Lee, and F. Wormwell. F. N. Speller. U. R. Evans (*Trans. Electrochem. Soc.*, 1932, 61, 455–457).—Cf. preceding abstract. G. D. B. and his collaborators A. R. L. and F. W. affirm that the primary air-formed oxide film has so slight and temporary an effect that it is negligible compared with that of other factors which set up a secondary distribution which is far more persistent. The failure of oxygen to produce a really protective film has been confirmed. Corrosion rates increase with oxygen pressure, and there is no sign of passivity. It is agreed that differential aeration gives most intense corrosion where the oxygen supply to the metal is greatest. U. R. E. quotes several of his earlier papers in reply. F. N. S. is of the opinion that the electrochemical explanation of the mechanism of corrosion would have been accepted sooner had it been realized that the initial distribution of corrosion attack is associated with breaks or weak points in the primary film. He cites experiments on Bessemer bars in which initial attack took place at different points not necessarily occurring in the segregated area. U. R. E. thinks that possibly the margins of certain inclusions might constitute weak places in the film.—W. A. C. N.

Film Reactions. Contribution to the Study of the Corrosion of Metals. Leif Tronstad (*Z. Metallkunde*, 1932, 24, 185–188).—Corrosion processes can be studied by means of microscopic investigation of reactions in films of high viscosity within which the corrosion products remain at their place of origin. With a film of 4% gelatin solution containing considerable amounts of a suitable indicator it can be shown that local corrosion of hard-rolled aluminium sheet is characterized by the generation of hydrogen and the dissolution of metal at pores or cracks in which the liquid is sufficiently acid to attack the metal.—M. H.

A Method for the Measurement of the Dissolution of Metals in Salt Solutions. L. Whitby (*Trans. Faraday Soc.*, 1932, 28, 474–478).—The specimen and a measured volume of corroding liquid are confined in a glass vessel containing a known volume of air and maintained at constant temperature in a thermostat. After a definite period of reaction the hydrogen evolved is measured by passing the gases over palladium-black and measuring the decrease in volume; oxygen is similarly determined using yellow phosphorus as the absorbent; the difference between that originally present and that present at the end of the test is the volume absorbed during corrosion. Tests with magnesium in 0.0001 and 0.001*N*-sodium chloride solution show that there is no appreciable absorption of oxygen in either case.—A. R. P.

Metals Resistant to Corrosion and Heat. [H. D. Phillips] (*Technique moderne*, 1930, 22, 705–706).—From *Heat-Treat. and Forging*, 1930, 16, 466–470. See this *J.*, 1930, 43, 511.—H. W. G. H.

PROTECTION

Protection of Aluminium Alloys against Corrosion by Means of Metallic Coatings Produced by the Schoop Spray Process. G. Akimov and W. Kroenig (*Korrosion u. Metallschutz*, 1932, 8, 115-119).—Duralumin can be protected satisfactorily from corrosion in sea-water by spraying with pure aluminium, zinc, cadmium, or a 17 : 83 zinc-cadmium alloy. Zinc should not be used when the material is to be subjected to intermittent immersion. The zinc-cadmium alloy affords the best protection in cases of continuous total immersion.—A. P.

The MBV-Method [for the Surface Protection of Aluminium and its Alloys]. Anon. (*Apparatebau*, 1932, 44, 102-103).—See *J.*, this volume, p. 481.—M. H.

Protection of Aluminium against Corrosion. H. Sutton (*South African Eng.*, 1932, 43, 155).—From a paper read before the Royal Aeronautical Society. See *J.*, this volume, pp. 234, 439.—P. M. C. R.

Aircraft Finishing. C. E. Kirkbridge (*Indust. Finishing*, 1930, 6, 14-18; *Amer. Paint Varnish Manuf. Assoc. Abs. Rev.*, 1930, 303).—The necessity for the anodic treatment of aluminium alloys which are used in aircraft construction and even aluminium alloys which have been plated by a relatively thin layer of aluminium, is stressed. K. states that anodizing is not sufficient protection, in that the slightest abrasive action tends to remove the film. A properly designed paint coating can be used to great advantage.—S. G.

On the Protection of Magnesium Alloys against Corrosion by Pickling Processes. W. O. Kroenig and G. A. Kostylev (*Korrosion u. Metallschutz*, 1932, 8, 147-151).—The efficiencies of six types of pickling bath for producing protective coatings on Elektron alloys have been examined. The best films were obtained in a solution containing 4% potassium bichromate and 18% nitric acid; this solution is used at 80° C., but can be used at room temperature if certain nitrates (nature not stated) are added. The protective efficiency of the film varies with the alloy, alloys containing aluminium giving the most protective films. The films withstand weathering and sea-water attack very well, but rapidly break down in tap water and distilled water. Pure magnesium cannot be protected in these solutions.—A. R. P.

Resistance to Sea-Water of Electrodeposited Coatings on Iron and Light Metals. Erich K. O. Schmidt (*Z. Flug. u. Motor.*, 1931, 22, 141-147).—Report No. 209 to the Deutsche Versuchsanstalt für Luftfahrt. Iron (carbon steel was actually used) was most efficiently protected by cadmium plating, which gave superior results to cadmium with a tin over-coating. Zinc and chromium plating, and red-lead coating, were ineffective. Some types of steel were scarcely attacked by sea-water. Cadmium plating was ineffective as a coating for electron; it gave good results with Duralumin and Lantal. India-rubber was usually ineffective, although in one case it protected both Duralumin and Lantal satisfactorily. Where light alloys are in contact with iron and steel, cadmium can be used between them, corrosion being then obviated by the differences in potential.—P. M. C. R.

Corrosion-Resistance of Aircraft Bracing Cables with Different End-Connections. Martin Abraham (*Wire and Wire Products*, 1931, 6, 283-289).—An official report of the Deutsche Versuchsanstalt für Luftfahrt. Three types of wire were used in manufacturing experimental cables to a quoted specification: (1) steel wire with pure zinc coating applied by the customary hot process; (2) steel wire coated with pure cadmium by the Udylyte process; (3) a stainless V2A-steel wire. Samples of each type were provided with sleeve, splice, and soldered terminals, and tensile tests were carried out on the series before and after corrosion attack by salt-water spray fog, with or without additional corrosion preventives. The results are tabulated with the loss of strength due to corrosion attack, three cables being tested in each set of conditions. Under salt-water spray-fog corrosion, cadmium-coated cables were greatly superior to

those coated with zinc, and occasionally better than the V2A steel cables: the latter are liable to failure under acid corrosion. "Aluminium-bronze" paint is found to be the most satisfactory additional preventive.—P. M. C. R.

Mottled Templates. J. C. Jones (*South African Eng.*, 1931, 42, 260).—From a paper read before the Iron and Steel Institute. See *J.*, this vol., p. 360.—P. R.

[Galvanized] Steel Embrittlement Given Thorough Investigation. C. S. Trewin (*Daily Metal Reporter*, 1931, 31, (100), 11).—From a paper read before the American Zinc Institute. A survey of preliminary work on the causes of brittleness in galvanized steel, carried out at the Battelle Memorial Institute under Sub-Committee X of Committee A-5 of the A.S.T.M. See abstract, *J.*, this volume, p. 550.—P. M. C. R.

Skimmer for Galvanizing Vessel. M. L. Hunker (*Machinery (N.Y.)*, 1930, 37, 94-95).—See *J.*, this volume, p. 438.—H. F. G.

Wire Galvanizing Processes. W. H. Spowers, Jr. (*Wire and Wire Products*, 1932, 7, 257-258, 273-274).—An analysis of the discussion on hot-galvanizing versus electro-galvanizing between L. D. Whitehead and G. K. Rylands, pointing out the relative advantages and disadvantages brought out in the discussion. (See *J.*, this volume, pp. 30-31, 235, and 306).—J. H. W.

Zinc Used in Metalware Galvanizing. Wallace G. Imhoff (*Amer. Metal Market*, 1932, 39, (127), 5, 8; (128), 5, 8; (130), 5; (131), 5, 8; *C. Abs.*, 1932, 26, 5535).—Zinc used in industry for galvanizing includes the following grades: electrolytic, primary distilled, secondary distilled, and remelted. The derivation and uses for the various types of secondary zinc are described. The Tainton electrolytic process using high acid and high current density can treat mixed ores and concentrates from a great variety of sources and give a product analyzing 99.99% zinc. In the field of metalware galvanizing very little, if any, electrolytic zinc has been used, and the standard metal for the purpose in use in the U.S.A. is known as "Prime Western." The specifications for the 5 grades of virgin spelter issued by the American Society for Testing Materials are discussed. It is pointed out that impurities not covered in the specifications, such as oxides and inclusions, can cause operating difficulties. The analysis of various baths used by different manufacturers are tabulated. Appearance, feel, gas cavities, toughness, fracture, &c., are all of importance in judging the suitability of a zinc for galvanizing, and must be considered in addition to its chemical composition.—S. G.

Painting of Galvanized Iron and Sheet Zinc. H. A. Nelson and R. W. Jamieson (*New Jersey Zinc Co., News Bull.*, 1928, Nov., 1-19; *Amer. Paint Varnish Manuf. Abs. Rev.*, 1930, 304).—Paint adheres with difficulty to sheet zinc and to galvanized iron because of their very smooth surfaces, their tendency to expand and contract with temperature changes, and the usual presence of a thin grease film. Natural weathering for 2-6 months is the best treatment prior to painting, but pretreatment by sand-blasting, etching, or washing may be applied. Formulæ for etching solutions are given. Matt-surface galvanized iron may be satisfactorily painted without ageing or pre-treatment. Experimental panels received 8 different pre-treatments and were then primed with red lead, Fe_2O_3 -ZnO, or zinc dust-ZnO paints and finished with ZnO-lithopone or white lead paints. Photographs of the panels after 2 years of exposure are shown, from which it is concluded that the particular chemical pre-treatment must be selected with regard to the primer to be used. Mechanical roughening, however, improves the results obtained with all paints.—S. G.

Recent Developments in Metal Lacquers. Kenneth R. Longnecker (*Quarterly Rev. Amer. Electroplaters' Soc.*, 1932, 19, (8), 31-36).—A brief account of the properties and uses of some of the newer lacquers made from synthetic resins.—A. R. P.

IV.—STRUCTURE

(Metallography ; Macrography ; Crystal Structure.)

(Continued from pp. 671-673.)

Photomicrographs at Low Magnification. James Osborn Lord (*Trans. Amer. Soc. Steel Treat.*, 1932, 20, 1-26).—Three main types of work are considered: the photography of opaque polished surfaces, of rough surfaces in low relief, such as deeply etched material or "square" fractures showing a fine grain, and of articles showing high relief, as in the case of coarse fractures, granules, crystals, and pieces containing cavities. An arrangement of vertical camera and horizontal illumination is described and illustrated, and the special adjustments of aperture, lighting, and background for each class of object are discussed. Sections on resolving power and numerical aperture, magnification and aperture, magnification and resolving power, depth of focus and definition, focal length and magnification, and depth of focus and depth of image deal with the theoretical bases of these values.—P. M. C. R.

The Practical Application of Electrochemistry to Modern Macrography. John H. Hruska (*Heat-Treat. and Forging*, 1931, 17, 1034-1037; and (summary and discussion) *Metallurgist* (Suppt. to *Engineer*), 1932, 8, 24-25).—An electrolytic method of macro-printing is described. The polished specimen is connected to the anode of a low-voltage circuit, the cathode being in connection with a metal plate of some material (*e.g.* stainless steel) which is readily kept bright and smooth. In contact with the specimen is placed a sheet of unglazed paper, soaked with a suitable electrolyte, and between this and the metal plate a sheet of paper soaked in a solution of a non-reactive salt is placed. The specimen, electrolytic paper, non-reactive paper, and base plate are closely assembled in the order mentioned, and on closing the circuit an image of the specimen is deposited on the base plate, any irregularities of structure or composition being reproduced. Some experimental details are given and the interpretation of results is discussed.—P. M. C. R.

Method of Preparation of Lead and Lead Alloy Cable Sheath for Microscopic Examination. W. H. Bassett, Jr., and C. J. Snyder (*Met. Ind. (Lond.)*, 1932, 41, 271-274).—Abstract of a paper read before the American Society for Testing Materials. See *J.*, this volume, p. 485.—J. H. W.

The Growth of Metal Crystals in Metal Vapours.—II. M. Straumanis (*Z. physik. Chem.*, 1932, [B], 19, 63-75).—(Cf. *J.*, this volume, 38.) The crystals formed in a hydrogen atmosphere of more than 4 mm. pressure have a different habit from those formed under lower pressure in that they have an apparently cubic structure. This behaviour accounts for the previously reported cubic modification of zinc. Slow growth promotes the formation of well-developed crystals.—v. G.

Diffusion in, and Decomposition of, Solid Solutions. A. Smekal (*Z. Metallkunde*, 1932, 24, 121-124).—Polemical against Hanemann and Schröder (cf. *J.*, this volume, p. 307). The differences in the decomposition of solid solutions by movement of atoms along straight lines of the lattice (in interstitial solid solutions) and by place changes of atoms (in substitution solid solutions) are due chiefly to the difference in the order of magnitude of the velocity of diffusion and decomposition. The concept of "perfusion" is shown to be untenable. The crystallographic oriented arrangement of the final shape of the segregations in the case of large amounts of segregations is ascribed to the effect of plastic deformation processes during decomposition.—M. H.

Contribution to the Paper by A. Smekal "Diffusion in, and Decomposition of, Solid Solutions." M. von Schwarz (*Z. Metallkunde*, 1932, 24, 124-126).—Cf. preceding abstract. The mechanism of decomposition of silicon-copper

solid solutions as shown by the polarization microscope is in good agreement with the conception of Smekal that plastic deformation occurs during segregation.—M. H.

Diffusion and Decomposition in Solid Solutions. H. Hanemann. A. Smekal (*Z. Metallkunde*, 1932, 24, 164-165).—Cf. preceding abstracts. Polemical. H. and S. give further examples in support of their previous contentions.—M. H.

Constitution of Solid Solutions. C. H. Desch (*Met. Ind. (Lond.)*, 1932, 41, 294).—Short abstract of a paper read before the Chemical Section of the British Association, giving a survey of recent work on transformations in solid solutions.—J. H. W.

Determination of Structure by Sound-Vibrations. A. Meissner (*Jahrb. Forschungs-Inst. A.E.G.*, 1930, 2, 265-270).—Any crystalline material shows peculiar types of vibration under acoustic stimulus, the vibrations depending on the shape and relative dimensions of the specimen and on the crystal structure of the material. The present investigation, primarily concerned with the quartz crystal, gave results which appear applicable to metals and other crystalline bodies, and which supplement radiological methods of investigating structure.—P. M. C. R.

Crystal Structure and Atomic Properties of Alloys Containing Transition Elements. Arne Westgren (*J. Franklin Inst.*, 1931, 212, 577-599; and (summary) *Metallurgist* (Suppt. to *Engineer*), 1932, 8, 27-29).—Although the experimental results are too incomplete to furnish a coherent idea of the subject, there is evidence, largely of an X-ray nature, that the divergence between the transitional elements and other metals manifests itself in no less than three different ways. Briefly summarized these are: (1) the transition elements alone are able to form phases with nickel-arsenide structure; (2) the reaction products when the transitional elements combine with hydrogen, boron, carbon, or nitrogen have metallic properties, which is not the case with other elements; (3) on combination with zinc, cadmium, or aluminium in certain proportions the transitional elements give rise to phases with the same structure as β or γ brass.—S. V. W.

Alteration in the Texture and Mechanical Properties of Duralumin as a Function of the Working and Subsequent Heat-Treatment. E. Bachmetew (*Light Alloys Research*, 1931, 1, (12), 6).—A short abstract from *Vestnik Metallo-promishlennosti*. Examination by X-rays of the changes of crystal structure in Duralumin during cold-rolling is stated to have shown that reductions of up to 89% in thickness produce a "simple orientation" but that greater reductions produce a state "characterized by two axes of orientation." Duralumin cold-rolled to 89% and more, and subsequently heat-treated and aged, exhibits a recrystallization structure. The resistance to temporary deformation of cold-rolled Duralumin increases considerably after 89% reduction; but is a maximum at 89% reduction after heat-treatment and ageing. Cf. this *J.*, 1931, 47, 187, 335, 535.—J. C. C.

The Mosaic Structure of Cobalt Crystals. Francis Bitter (*Phys. Rev.*, 1932, [ii], 40, 125).—Abstract of a paper read before the American Physical Society. Since making a preliminary report on the detection of magnetic inhomogeneities by means of magnetic powders (*Phys. Rev.*, 1931, [ii], 38, 1903), cobalt, having a hexagonal lattice, has been produced in slabs with large grains and a shiny smooth surface. Very distinct deposits were obtained on these samples before they were magnetized. The patterns may be classified into 2 types: (1) a series of parallel straight lines roughly similar to those found in nickel and iron; and (2) a deposit which divides the metal into regions of various sizes (roughly from 0.1 to 0.01 mm. in diam.) more or less regularly arranged at the corners of adjacent hexagons. The general aspect of this latter type of pattern resembles a delicate lace-work. When the samples are

magnetized this breaks up into a series of parallel lines, which are in general not quite straight. Until conclusive experimental verification is available, it seems reasonable to assume that these two types of deposit occur on grains the hexagonal axes of which are respectively in and normal to the surface. These results furnish direct experimental verification of the existence of a block structure, as predicted by Zwicky.—S. G.

X-Ray Study of the Plastic Working of Magnesium Alloys. L. G. Morell and J. D. Hanawalt (*Phys. Rev.*, 1932, [ii], 40, 1035).—Abstract of a paper read before the American Physical Society. An X-ray study has been made of the structure of magnesium alloys fabricated at various temperatures. Different processes of working such as rolling, forging, or extruding result in characteristic fibre structures as seen by the X-ray photograms. These patterns are identified by comparing with computed patterns for the hexagonal system with axial ratio $c/a = 1.62$. In this way it is found that a forged magnesium alloy possesses a [001] fibre axis lying in the direction of forging, whilst extruded magnesium alloys show a [210] fibre axis lying in the direction of extrusion. These results are understood in terms of the planes and direction of gliding in the micro-crystals in polycrystalline magnesium. The X-ray diagrams serve also to show the grain-size and distortion of the micro-crystals as a function of the temperature and the degree of working.—S. G.

New Orientations Forming in a Crystal of Ag-Cu During Precipitation. C. S. Barrett and H. F. Kaiser (*Phys. Rev.*, 1932, [ii], 40, 1035).—Abstract of a paper read before the American Physical Society. The orientation of individual grains of a solid solution of copper in silver (4% copper by weight) has been studied by means of X-rays before and after annealing, with surprising results. X-rays reflected from a single grain in the quenched homogeneous alloy give strong and well-defined spots, but these spots completely disappear after annealing treatments varying from 7 to 38 hrs. at 300° C. Before the original spots have vanished new reflections appear, weak and elongated. These occur at different angles indicating reflection from the solid solution instead of the precipitate. These reflections are not destroyed by further annealing. Photograms of these reflections on a Davey-Wilson camera, when analyzed by stereographic projection, disclose a series of new orientations of fragments of the original crystal. The new orientations are related to the orientation of the original crystal by rotations covering the angular range 36°–54° about each of the axes [100], [010], and [001], of the original matrix. There is a preference for rotations of approx. 42° and 48° about these axes corresponding with the fragmentation of a single crystal into crystallites with 6 different orientations. No type of twinning previously observed in metals accounts for such an effect; it can be explained by twinning only by going to high index planes as twinning planes, such as those of the form {830}, {940}, or one intermediate between these. Photomicrographs were taken at the different stages of the process, and although the grains ceased to have the appearance of a homogeneous solid solution, neither characteristic twinning structures nor the Widmanstätten structure appeared.—S. G.

The Crystal Structure of the Regular Sodium-Tungsten Bronzes. W. F. de Jong (*Z. Krist.*, 1932, 81, 314–315; *Brit. Chem. Abs.*, 1932, [A], 450).—The structure of these bronzes closely resembles that of KIO_3 , with $a = 3.83$ Å. Analysis shows results between $Na_8(WO_3)_2$ and $Na_2(WO_3)_7$, with part of the sodium replaced by hydrogen in the red and violet varieties.—S. G.

Methods for Computing Lattice Energy Constants. R. H. Canfield (*Phys. Rev.*, 1932, [iii], 40, 1034).—Abstract of a paper read before the American Physical Society. The classical methods for calculating lattice energies depend on the existence of special functions which limit the symmetry of the lattices to which they may be applied. The present paper describes 2 methods applicable to lattices of any symmetry. The first method, applied to the

Coulomb potentials, involves the calculation of the potential of an ion at the centre of an ever-enlarging sphere of crystal-lattice. At each step a special correction layer is added, such that the net charge of the whole sphere is zero and the volume integral of the potential energy is zero. This progression approaches a limit which may be determined to 4 digits by plotting. The second method is applied to potentials having exponents of $1/r$ higher than 3. In this method the energy is computed exactly for a large sphere of surrounding atoms, and the remainder of the crystal to infinity replaced by a volume integral over a uniform distribution of matter. The lower limit of this integral is the boundary of a sphere containing matter equal to the actual content of the crystal sphere which furnishes the main term. This method gives results to 6 digits. Numerical results are given.—S. G.

X-Ray Diffraction Patterns of Mixtures. M. Y. Colby (*Phys. Rev.*, 1932, [ii], 39, 861).—Abstract of a paper read before the American Physical Society. Experiments have been carried out to duplicate those of Drier (*ibid.*, 1931, [ii], 37, 712), in which powder photographs of mixtures of zinc and copper at room temperature invariably exhibited 8 lines that did not appear on the composite diffraction pattern of the components. These extra lines were attributed to α -brass. By using freshly prepared zinc and copper filings (200-mesh) sealed in Pyrex capillary tubes, powder photographs were obtained with G.E.C. X-ray diffraction apparatus. They show no extra lines. In agreement with Kenney and Aughey (*ibid.*, 1931, [ii], 38, 1388), the photographs of the mixture are identical with the composite photographs of the components in every case. Using a mixture of freshly prepared copper dust and old zinc dust, 8 lines appear, belonging to neither copper nor zinc. These "extra" lines, however, correspond exactly with the 8 strong lines of zinc oxide.—S. G.

Diffraction of Electrons by Metal Surfaces. C. J. Davisson and L. H. Germer (*Phys. Rev.*, 1932, [ii], 40, 124).—Abstract of a paper read before the American Physical Society. Beams of electrons were directed on etched metal surfaces at angles averaging 2° from grazing (G. P. Thomson method). Scattered electrons were photographed and the diffraction patterns studied. Diffraction patterns were obtained from polycrystalline gold, tungsten, molybdenum, cobalt, nickel, chromium, and platinum, and from single crystals of nickel and tungsten. Electron speeds correspond with voltages from 13,000 to 55,000. The metals gold, tungsten, molybdenum, and cobalt give Debye-Scherrer rings characteristic of the known structures of the metals. About 20 rings are usually found. Nickel gives simultaneously rings of Ni and NiO. Chromium etched in dilute hydrochloric acid gives hexagonal chromium rings. After re-etching in warm, concentrated hydrochloric acid the pattern consists only of spots. Their radial distances are not inconsistent with the rhombohedral structure of CrCl_3 (large crystals). The nickel crystal gives two orders of Bragg reflection from the (111) surface planes. The tungsten crystal gives four orders of Bragg reflection from the (110) surface planes. Re-etching produced, in addition, five orders of Bragg reflection from planes of unknown origin spaced at 2.97 Å. After standing in air for 1 month the pattern consisted only of 15 small rings which indicate a body-centred cubic structure of constant 7.4 Å.—S. G.

Some Recent Experiments on Electron Diffraction. G. P. Thomson (*Rep. Brit. Assoc.*, 1931, 327).—A short description of the application of electron diffraction to the examination of metal surfaces.—E. S. H.

Deflection of Electrons by Adsorbed Gaseous Layers on Metallic Surfaces. E. Rupp (*Jahrb. Forschungs. Inst. A.E.G.*, 1930, 2, 277–285).—In the presence of adsorbed gaseous layers, X-ray examination fails, since its result is the combined effect of two differing sets of space-lattices, and therefore gives an accurate register of neither surface nor base material. The deflection method, details of which are given and illustrated, has here been applied to adsorbed argon,

hydrogen, and nitrogen on nickel, hydrogen and nitrogen on iron, hydrogen on copper, and hydrogen and nitrogen on molybdenum and on zirconium. Argon appears to exert no effect on the lattice of nickel; hydrogen has marked effects, nitrogen acts similarly on molybdenum but much more feebly in other cases. The nitrogen-hydrogen interaction on the surface of iron and nickel is studied, as are certain exceptional surface-reactions of copper.—P. M. C. R.

The Calculation of the Number and Size Distribution of Spherical Crystals in Opaque Bodies by Means of Circular Sections on a Plane Section. Erich Scheil (*Z. anorg. Chem.*, 1931, 201, 259-264).—Mathematical.—B. Bl.

V.—ANALYSIS

(Continued from pp. 673-677.)

Quantitative Spectrographic Analysis. O. S. Duffendack and T. A. Wolfe (*Phys. Rev.*, 1932, [ii], 40, 1038).—Abstract of a paper read before the American Physical Society. A method of quantitative spectrographic analysis based on the relative intensities of selected spectra lines in a single spectrogram has been developed and shown to give as consistent results as quantitative chemical analysis. By determining the relative intensities of a selected pair of lines in a graduated series of specimens like the material under investigation, a working curve can be determined giving the relationship between the relative intensities of the lines and the percentage of the test element. This curve need be determined but once for analyses over a given percentage range. Hansen's step diaphragm method of measuring relative intensities of spectral lines is used. When the test material is an alloy, an arc source is preferred. Investigation revealed that at certain arc currents, the relative intensity of the selected lines varies only slightly with the currents. An arc of this current is used for the analysis. A theory of the intensities of spectral lines in an open arc has been developed and accounts for the relations used in this method.—S. G.

Quantitative Analysis by X-Ray Spectroscopy. C. E. Eddy and T. H. Laby (*Proc. Roy. Soc.*, 1930, [A], 127, 20-42; *Brit. Chem. Abs.*, 1930, [A], 724).—Previous work on the X-ray emission spectra method has been extended and developed as a method of quantitative analysis. Details are given of the experimental arrangements, the X-ray tube, and the method of calibration of the photographic films. A number of factors, e.g., line intensity and applied potential, non-homogeneous targets, comparison of lines of different wavelength, are discussed and tested by experiment. The method has been applied to several alloys of Cu and Zn, Sn-Cd, Pb-Bi, Zn-Cu-Sn, and Sn-Zn. With alloys of nearly equal atomic number the method has an accuracy of 0.5%; successful preliminary experiments have also been made with alloys of elements of unequal atomic number. The results obtained are not in agreement with those of Coster and Nishina (*Chem. News.*, 1925, 30, 149), who found that the presence of a third element affected the values, or with those of Gunther and Stranski (*Z. phys. Chem.*, 1923, 106, 433), who found that the ratio of the intensities of two lines of a given element was dependent on their absolute intensities. A comparison is made of the X-ray emission method with other methods of spectral analysis. The former is extremely useful in testing the purity of metals to be used for the accurate determination of their physical properties.—S. G.

Spectrographic Means for Metallurgical Analysis. Anon. (*Technique moderne*, 1930, 22, 435).—Briefly discusses methods and apparatus recommended by Messrs. Adam Hilger, Ltd.—H. W. G. H.

Spectroscopic Apparatus in Industry. Charles C. Nitche (*Mech. Eng.*, 1931, 53, 123-126; and (abstract) *Met. Ind. (Lond.)*, 1931, 38, 139-140).—Read before the American Society of Mechanical Engineers. The elementary

principles of spectroscopy are stated, and the extreme sensitiveness of the spectroscope is emphasized. The apparatus and its use in qualitative and quantitative analysis are described, and future applications are suggested.

—P. M. C. R.

The Unit of Atomic Weight. F. W. Aston (*Rep. Brit. Assoc.*, 1931, 333-335).—A discussion of the divergencies in the physical and chemical points of view, especially in the light of the newly discovered isotopes of oxygen. It is recommended to retain the present chemical scale of atomic weights, but to use the standard of the oxygen isotope O^{16} for the more fundamental requirements of physics.—E. S. H.

Standard Methods for the Sampling and Analyzing of Aluminium and Certain Aluminium Alloys. Anon. (*Aluminium Research Institute*, 1932, 1-24; and (summary) *Light Metals Research*, 1932, 2, (16), 11-12).—Methods are given for the determination of Cu (iodide and electrolytic), Fe, Pb (electrolytic and sulphate-chromate), Mg, Mn (persulphate), Ni (dimethylglyoxime), Si (mixed acid and $HClO_4$ methods), Sn (iodate), and Zn (NH_4Hg thiocyanate and oxide). No novel procedures are recommended, but the details are standardized. Sampling procedure is also discussed.—A. R. P.

Gases in Metals. Anon. (*Metallurgist* (Suppt. to *Engineer*), 1932, 8, 149-150).—A critical summary, referring to other work on the same subject, of a paper by N. A. Ziegler read before the Electrochemical Society. See *J.*, this volume, p. 674.—R. G.

A Method for the Separation of Rhodium from Iridium and the Gravimetric Determination of these Metals. Raleigh Gilchrist (*U.S. Bur. Stand. J. Research*, 1932, 9, 547-556; *Research Paper No. 489*).—The chloride solution of the metals is evaporated with 10 c.c. of H_2SO_4 and 2-3 c.c. of HNO_3 until heavy fumes are evolved; after diluting to 200 c.c. the boiling solution is treated with 20% $TiCl_3$ solution until the Rh is precipitated as metal and the solution remains purple. The Rh is washed with dilute H_2SO_4 , redissolved by strongly heating with 10 c.c. of H_2SO_4 and fuming HNO_3 , and reprecipitated as before. The second Rh precipitate is dissolved in H_2SO_4 and the solution boiled with 20 c.c. of H_2O and 10 c.c. of HCl and diluted to 400 c.c.; Rh is then precipitated with H_2S , and the Rh_2S_3 converted into Rh for weighing. The filtrates from the $TiCl_3$ treatment contain the Ir and $Ti(SO_4)_2$; the latter is removed by precipitation with cupferron at 0° - $5^{\circ}C.$, the excess of reagent is destroyed by evaporation of the solution with HNO_3 , and the Ir precipitated by neutralizing to pH 6 and boiling with $NaBrO_3$. The black IrO_2 , aq. is washed with 1% NH_4Cl , dried, ignited, and reduced in H_2 to Ir for weighing.—A. R. P.

VI.—LABORATORY APPARATUS, INSTRUMENTS, &c.

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

(Continued from pp. 677-678.)

Metallographical Microscopy by Means of Polarized Light. Anon. (*Metallography*, 1932, 6, 198).—The application of polarized light to investigations of non-ferrous alloys, for obtaining information about the anisotropy, orientation, and state of tension of the crystallites of the metal, is handicapped by the fact that vertical incidence of light is necessary, and this is not readily obtained when large magnifications are desired. Two epiphragms have been devised, one for obtaining a uniform angle of incidence, and the other for obtaining a uniform angle of incidence and azimuth. These are fitted directly after the condenser lens and are particularly advantageous at high magnifications, although photography may be rendered more difficult due to the reduced intensity of the light.—J. W. D.

Microscopes Applied to Metallurgy. M. Patel (*Aciers spéciaux*, 1930, 3, 493-497).—Notes on metallurgical microscopes.—J. H. W.

Microscopes. Maurice Blood (*J. Sci. Instruments*, 1932, 9, 64-68).—A description without details of some of the exhibits at the twenty-second Annual Exhibition of the Physical and Optical Societies. These include (a) binocular microscopes by R. and J. Beck, Ltd, E. Leitz, and Carl Zeiss, Ltd.; (b) new or modified types of metallographs by E. Leitz, W. Watson & Sons, Ltd., and Carl Zeiss, Ltd.; (c) the new "Ultropak" illuminator of E. Leitz—this is an opaque illuminator which throws on the object a concentrated hollow cone of light outside the angle of the objective. For high-power metallographic work the image is the reverse of that given by an ordinary vertical illuminator, almost as a negative photograph is the reverse of a positive print.—W. H.-R.

The Physical and Optical Societies' Twenty-Second Annual Exhibition. Anon. (*J. Sci. Instruments*, 1932, 9, 33-80, 81-112).—These two numbers contain brief accounts of a large number of the exhibits at the Annual Exhibition of the Physical and Optical Societies. The sections referring directly to metallurgical work are dealt with in other abstracts, but apparatus of indirect interest will be found in many sections to which reference should be made. These sections deal with photo-cells, photographic shutters, lecture, instructional, and educational apparatus, optical instruments, radio instruments, and laboratory electrical instruments.—W. H.-R.

Simplification of Marten's Mirror Apparatus. E. Hesse and H. J. Wiester (*Z. V. d. I.*, 1932, 76, 785).—The mirror is so clamped against the measuring spring by means of a thin wire spring that it cannot fall out and yet is not hindered in its movements. By replacing the plane with a spherical mirror the observation telescope is unnecessary.—v. G.

A Device for Obtaining Very Small Electric Currents of Known Magnitude. Lloyd P. Smith (*Rev. Sci. Instruments*, 1931, 2, 237-241).—The positive or negative electric emission from heated tungsten is utilized to provide a source of very small electric currents of known magnitude of the order 10^{-12} to 10^{-15} amp.—J. S. G. T.

A 200,000-Volt X-Ray Tube. William W. Hansen (*Rev. Sci. Instruments*, 1931, 2, 820-823).—An experimental 200-kv. X-ray tube and associated pumping system are described and illustrated.—J. S. G. T.

A Precision X-Ray Spectrometer, and the Wave-Length of $\text{Mo } K\alpha_1$. Arthur H. Compton (*Rev. Sci. Instruments*, 1931, 2, 365-376).—An X-ray ionisation spectrometer for precision measurements, using two or more crystals in series, of which the last is mounted over the axis of the divided circle, is described.—J. S. G. T.

VII.—PHYSICAL AND MECHANICAL TESTING AND RADIOLOGY

(Continued from pp. 679-680.)

Recent Advances in the Methods of Control of Metallurgical Products. P. Nicolau (*Bull. Soc. d'encour. ind. nat.*, 1929, 117-150; and (summary and discussion) *Metallurgist* (Suppt. to *Engineer*), 1930, 6, 84-85).—Testing methods are described.—S. G.

Choosing Samples for Testing. — Nicolau (*Usine*, 1931, 40, (2), 31).—Abstract of a paper read at the Congrès International de Sécurité Aérienne. Since the safety of a structure depends on the minimum mechanical properties of any element, a satisfactory testing procedure should determine these. The heterogeneity of the material should be explored and test-pieces taken from parts found to be suspect, and in the most unfavourable orientation. The size of these test-pieces should be reduced to localize the test in the suspected zone.—H. W. G. H.

On the Question of Standardization of Methods of Testing Materials. A. Zernov (*Vestnik standartizatsii* (*Messenger of Standardization*), 1927, (3), 31-

33).—[In Russian.] The possibility of standardizing mechanical tests is examined, and the necessity for standardization is emphasized.—N. A.

Destructive and Non-Destructive Tests: A Critical Discussion of Methods of Testing Welds and the Significance of Results. J. R. Dawson and A. B. Kinzel (*Indust. Gases*, 1932, 13, 89-95).—Read before the International Acetylene Association. See this *J.*, 1930, 43, 571.—H. W. G. H.

Note on Non-Destructive Methods of Testing Welds and their Possible Applications to Welded Steel Structures. G. A. Hankins (*Elect. Welding*, 1932, 1, (5), 4).—Short abstract of a paper read before the International Association for Bridge and Structural Engineering. Magnetic tests, electrical tests, X-ray examination, and the stethoscope test are discussed.—H. W. G. H.

On the Theory of Wear. H. Friedrich (*Maschinenbau*, 1930, 9, 129-131; *Eng. Index*, 1930).—Comparison is made between abrasion by friction and by machinery, e.g. grinding, filing, sawing, &c., in order to find an explanation for the theory of wear. Experiments carried out on an abrasion-testing machine are discussed and calculated, and measured values are compared.—S. G.

The Difficulties of Wear Testing. R. Guillery (*Usine*, 1931, 40, (2), 33).—Abstract of a paper read at the Congrès International de Sécurité Aérienne. The main difficulty in wear tests is the time factor, and a determination of the coeff. of friction is suggested as the best substitute. A machine is described for carrying out this determination under known conditions of lubrication, pressure, temperature, &c.—H. W. G. H.

The Effect of Temperature on Some of the Physical Properties of Metals. F. C. Lea and C. F. Parker (*Engineering*, 1932, 133, 23-26, 54-55).—From a paper read before Section G of the British Association, September 1931. The apparatus used for determining the extent of creep at various temperatures in tension and under torsion is described and illustrated. Full details of certain tests on alloy and carbon steels and on cupro-nickel are given and discussed. The curves show the importance of temperature control and of the time-factor; the amount of creep, after a sharp initial rise, remains almost unaltered for long periods with constant temperature. Complicating factors are surface and inter-crystalline corrosion, changes in the effective dimensions of the material, and local concentrations of stress. Using the Haigh machine, tests on material under repeated equal tensile and compressive alternating stresses showed some extension of the test-piece. Curves obtained from spiral springs are also given. Possible changes taking place in materials on exposure to high temperatures may be investigated by impact tests after cooling, hardness tests after cooling, and micro-examination; the results obtained by these methods are discussed. L. and P. consider that for many purposes the shear stress creep test is not only the most easily and accurately performed, but that it also gives the stress values which should help to determine the permissible allowance for creep in special cases. A brief reference is made to the increase on shear stress of certain structural forms.—P. M. C. R.

Testing of Materials for Service in High-Temperature Steam-Plant. R. W. Bailey and A. M. Roberts (*Proc. Inst. Mech. Eng.*, 1932, 122, 209-284; discussion, 298-377; and (abstract) *Colliery Guardian*, 1932, 145, 297).—The details of this paper refer to (1) the effect of temperature on carbide spheroidization in carbon steels in different conditions, (2) the effect of spheroidization on resistance to creep at different temperatures, and (3) experimental details of creep tests on steels at temperatures up to 600° C., and (4) a discussion of the results with special reference to their bearing on the requirements of steam power plant operating at high temperatures. The following points are of general interest: (a) An apparatus for creep tests is described in detail. In this the specimen is held inside a tube furnace, and temperature control to within $\pm\frac{1}{2}$ ° C. is maintained by means of a relay operated by the expansion of

the furnace tube made of heat-resisting steel. The temperature distribution along the specimen is made constant by means of a suitably graded winding. For comparatively coarse measurements down to 10^{-5} in. strain per hour use is made of a $\frac{1}{1000}$ -in. dial indicator at the end of a lever. A Marten's type mirror extensometer is used for more refined readings. Tests on the same material have been made by this apparatus, and at the National Physical Laboratory, and a very close agreement is found. (b) A testing machine for slow-rate tensile tests at high temperatures is described briefly, and enables tests to be made at 0.001 and 0.25 in. strain per minute. (c) A tensile test on notched specimens is described, and is useful for revealing embrittlement which may not be shown by an ordinary tensile test. It provides local stress concentration such as may occur in screws or bolts. (d) The process of spheroidization of carbide obeys a law of the type $t = Ae^{b/T}$, where t is the time taken for a given degree of spheroidization to occur at temperature T , and A and b are constants, b having the same magnitude for all steels tested. This law is deduced theoretically, and B. and R. suggest that it may hold for many structural changes in other alloys. (e) The process of creep is divisible into two stages. At first the creep is comparatively rapid and then diminishes. This corresponds with the attainment of uniform conditions within the metal, since the initial conditions may be variable owing to different grain orientation, &c. In the second stage after uniform conditions are established, the creep is slow, and gradually increases. (f) The paper is followed by a lengthy discussion with special reference to "limiting creep stresses" which B. and R. consider to have no real existence.—W. H. R.

An Accelerated Test for the Determination of the Limiting Creep Stress of Metals. W. Barr and W. E. Bardgett (*Proc. Inst. Mech. Eng.*, 1932, 122, 285-297; discussion, 298-377; also (summaries) *Engineer*, 1932, 153, 241-242; and *Mech. World*, 1932, 91, 245-247).—Cf. preceding abstract. In this test the specimen is heated in a vertical tube furnace maintained at constant temperature by means of a thermostat device. Tensile stress is applied by means of a screw, and the specimen is connected to a weigh-bar projecting below the furnace. An extensometer is fitted to the weigh-bar, and, by means of a previous calibration in a tensile machine, the reading of the extensometer enables the actual stress on the specimen to be determined. The test is begun at a known initial stress, and the reading of the extensometer is noted. If any creep occurs in the test-piece, the stress on the weigh-bar is released, and the extensometer reading changes. Experiments at different initial stresses enable one to estimate the stress which will give no measurable creep in a period of 48 hrs., and this is taken as the limiting creep stress, corresponding with a total creep of less than 7×10^{-6} in. for the period of test. In the discussion (cf. preceding abstract) the existence of a real limiting creep stress is questioned, but the test is claimed to be valuable for a rapid preliminary selection of materials.—W. H. R.

New Italian Machine for Determination of Brittleness of Metals. E. de Lutis (*Ingegneria (Roma)*, 1929, 3, 720-722; *Eng. Index*, 1930).—Describes the construction and use of a machine invented by Castiello and adopted by the Italian Navy. The machine determined resilience exactly without correction, and hardness and resistance approximately.—S. G.

Mechanical Tests of Materials of Low Capacity for Permanent Deformation. Albert Portevin (*Usine*, 1931, 40, (2), 33).—Abstract of a paper read at the Congrès International de Sécurité Aérienne. The reasons are discussed for using materials having low capacity for permanent deformation, and suitable tests for them are recommended.—H. W. G. H.

Elastic Constants of Metals. J. Galibourg (*Usine*, 1931, 40, (2), 31 and 33).—Abstract of a paper read at the Congrès International de Sécurité Aérienne. The importance of the elastic limit in design is emphasized. It

is the principal mechanical characteristic controlling the resistance of a material to repeated stresses.—H. W. G. H.

A Study of Slip Lines, Strain Lines, and Cracks in Metals under Repeated Stresses. Herbert F. Moore and Tibor Ver (*Univ. Illinois Bull.*, 1930, 27, (*Eng. Exper. Sta. Bull.* No. 208), 7-62).—Fatigue tests were made on rotating beam specimens of iron, 3 steels, brass, Monel metal, and Duralumin having two turned-down sections each subjected to the same range of stress. When one side broke, the other, although unbroken, had been subjected to repeated stress sufficiently high to cause "fatigue damage" to the structure. The properties of this portion were compared with those of an undamaged portion of the specimen which had been turned down to the size of the damaged portion. In the case of the non-ferrous metals there was little difference in the hardness of the two portions, but the fatigue-damaged portion showed a slightly higher yield-point in the tensile test. The reduction in area of the damaged brass was less than that of the undamaged metal, but no difference was observed in this respect between the two portions of Monel metal and Duralumin. The slip lines showed in all cases that slip tends to occur in the direction of maximum shearing stress, and that the fatigue cracks follow the direction of the slip lines, although in the case of the non-ferrous metals they often appear before the latter are visible.—A. R. P.

Measurement and Recognition of Internal Work Absorption of Materials. W. Späth (*Arch. Eisenhüttenwesen*, 1931-1932, 5, 587-590).—The internal losses in alternating fatigue tests can in the ideal case be represented by the phase displacement between the sine-shaped loading curve and the deformation. This "loss angle" can be measured accurately and continuously with a simple optical apparatus in alternating rotation bending tests.—J. W.

Dynamic Testing on Structural Members for Aircraft. Heinrich Hertel (*Z. Flug. u. Motor.*, 1931, 22, 465-474, 489-502).—Dynamic tests must supplement static testing in aircraft construction, since the former results become increasingly significant with the increase of speeds of flying under difficult conditions. In these circumstances, stress concentrations set up by abrupt alterations in section or by rivet-holes become important. Twelve beams, of welded, riveted, and latticed steel, of Duralumin (lattice), and of wood, were submitted to autographically recorded tests and the results of torsional, vibration, and endurance tests evaluated. The methods of testing, load distribution, and support are given, and typical fractures are illustrated.

—P. M. C. R.

Optico-Photographic Measurement of Deformation in Aircraft. Hans Georg Küssner (*Z. Flug. u. Motor.*, 1930, 21, 433).—Report to the Deutsche Versuchsanstalt für Luftfahrt. Dynamic stresses on aircraft have until recently been calculated in terms of live load, with or without a correcting factor. The principle of the optograph, which automatically makes a photographic record of deformations in any given portion of wings or body, is fully explained and illustrated, earlier optical, mechanical, electrical, and acoustic methods of determining certain stresses being briefly described for purposes of comparison. The optograph is capable of much wider application than its predecessors. The method of working is fully described, and several specimen curves are submitted.—P. M. C. R.

New Experimental Method of Investigating Elastic Stress. C. Fabry (*Compt. rend.*, 1930, 190, 457-460; *Eng. Index*, 1930).—A modification of the photo-elastic method for investigating stresses in structural members by the examination in polarized light of conventional glass models. Variations in optical instead of in actual thickness of the glass are measured, so that no mechanical contacts are necessary. The measurements are made with the Michelson interferometer.—S. G.

Method for the Technical Determination of Cohesion. W. Kuntze (*Metallwirtschaft*, 1932, 11, 343-347).—The various sources of error in K.'s notched-bar impact test are discussed. The specimen should be 50 mm. long, 10 mm. in diam., with a notch 3 mm. wide with an angle of 135° and a curve of 0.1-0.15 mm. at the bottom. The cohesion strength is obtained by plotting the tensile strength of this rod and that of a similar rod without notch and extrapolating linearly to zero notch. With materials very sensitive to notching a correction must be applied; this is determined by means of a tensile test on a specimen with a 60° notch. The extrapolation in this case is, however, very uncertain. The significance of the cohesion strength determination on the problem of notches, fatigue fracture, and the technical machinability of metals is discussed.—v. G.

Shock Tests. E.-L. Dupuis (*L'Usine*, 1931, 40, (2), 33).—Abstract of a paper read at the Congrès International de Sécurité Aérienne. Emphasizes the need for international standardization of impact testing.—H. W. G. H.

A New Method for Measuring the Mechanical Properties of Metals. L. H. Hounsfield (*Soc. Chem. Ind., Chem. Eng. Group, Advance copy*, 1932, 1-16; and (short abstract) *Met. Ind. (Lond.)*, 1932, 40, 223).—The Tensometer, an automatically recording testing machine, is adapted for tensile, transverse, bending, and shock testing on small specimens. The method of testing is fully described and illustrated, and the interpretation of records is discussed, with reference to curves obtained for pure gold, as annealed and after cold-rolling, pure annealed and commercial platinum, pure silver as annealed and as cold-rolled, malleable cast iron, cadmium, aluminium, zinc, nickel, and nickel-brass. The meaning of elastic limit, yield-point, proof stress, ultimate stress, stress at fracture, elongation, and reduction of area is discussed. Certain popular misconceptions with regard to fractures and the use of small test-pieces are attacked. Some adaptations for very weak materials and for testing strip are described.—P. M. C. R.

The Relation Between the Tensile Strength and the Hardness of Metals. O. Schwartz (*U.S. Nat. Advis. Cttee. Aeronautics, Tech. Mem. No. 552*, 1930, 1-15).—Translated from *Z.V.d.I.*, 1929, 73, 792-797. See this *J.*, 1930, 43, 575, and 1930, 44, 599.—S. G.

How Designers Can Appraise Metals from Hardness Test Data. E. S. Ault (*Machine Design*, 1930, 2, (2), 35-38; *Eng. Index*, 1930).—Fundamentals of hardness testing and classification of purposes are discussed. The Rockwell, Brinell, and Vickers hardness testing machines are described.—S. G.

The Hertz [Definition of] Hardness. R. Esnault-Pelterie (*Usine*, 1931, 40, (2), 33).—Abstract of a paper read at the Congrès International de Sécurité Aérienne. Incomplete.—H. W. G. H.

[Report on the] Pendulum Hardness Tester. Committee on Science and Arts of the Franklin Institute (*J. Franklin Inst.*, 1931, 212, 376-386).—The Committee investigated the pendulum hardness tester invented by E. G. Herbert. The report is reproduced at length, the conclusions being that "the Institute feels that in two respects the instrument under consideration is superior to other existing hardness testers. First, it appears to be better adapted to measuring the hardness of a thin sheet of metal; secondly, it appears to be the only instrument capable of developing and measuring the hardness produced by the working of a material."—S. V. W.

Determination of Hardness, Superficial and Local, by Means of the Pendulum. P. Le Rolland (*Usine*, 1931, 40, (2), 33).—Abstract of a paper read at the Congrès International de Sécurité Aérienne. The hardness is determined by the time of swing of a pendulum oscillating about a hard steel cylinder or ball resting on the surface of the material. The disadvantages of the Brinell and Rockwell tests are said to be eliminated.—H. W. G. H.

The Industrial Control of the Hardness of Metals. Jean Bodet (*Science et la Vie*, 1930, 37, 243-244).—The Brinell hardness test neglects deformation undergone by the ball in testing hard materials, and the errors introduced by the small size of the impression in such cases; the elastic recoil of the sample is also overlooked. Sclerographic (rebound) methods are preferred by B., who indicates, however, limitations arising from supercooling in the case of certain amorphous materials.—P. M. C. R.

On the Deflection of Electrons by Tungsten Coated with Oxygen. W. Boas and E. Rupp (*Jahrb. Forschungs-Inst. A.E.G.*, 1930, 2, 289-296).—Experimental details are given for the preparation of oxygen-coated tungsten test-pieces, and for the method of testing, diagrams of the apparatus, the support for the test-piece, and the circuits employed being appended. Sources of error are indicated and discussed. From tests carried out on pure and on oxygen-coated tungsten, B. and R. find the average internal potential for various angles of incidence for pure tungsten; the oxygen-coated metal shows marked differences, which are tentatively explained. The covering layer of oxygen is found to be monatomic in character, and to have similar properties to those of the passivating layer found in the case of iron.—P. M. C. R.

RADIOLOGY.

Method of Studying Aircraft Materials by Means of X-Rays. J. Trillat (*Usine*, 1931, 40, (2), 31).—Abstract of a paper read at the Congrès International de Sécurité Aérienne. The scope of X-ray spectrography and radiography is briefly outlined.—H. W. G. H.

X-Ray Examination of Aero Materials by the D.V.L. Kurt Matthaes (*Z. Flug. u. Motor.*, 1932, 23, 459-464).—The apparatus installed by the Deutsche Versuchsanstalt für Luftfahrt is described and illustrated. Methods of X-ray examination in the case of castings and welds are described, and certain limitations are indicated.—P. M. C. R.

X-Rays in Engineering Practice. V. E. Pullin (*South African Eng.*, 1931, 42, 150).—Abstract of a paper read before the Institution of Mechanical Engineers. See this *J.*, 1931, 47, 545.—P. M. C. R.

X-Raying Prevents Foundry Losses. W. S. Werner (*Iron Age*, 1930, 125, 1290-1291; *Eng. Index*, 1930).—A brief description is given of general equipment and procedure. Examples of defects found in iron and non-ferrous castings are illustrated by means of radiographs, and interpreted.—S. G.

What the X-Ray Tells about Castings. R. K. A. (*Machinery (Lond.)*, 1932, 40, 230-231).—See *J.*, this volume, p. 680.—J. C. C.

The Technic of Radiography by Gamma Rays. Charles S. Barrett, Roy A. Gezelius, and Robert F. Mehl (*Radiology*, 1931, 16, 461-476).—Reprint from *Metals and Alloys*, 1930, 1, 872-879. See this *J.*, 1931, 47, 219.—S. G.

Radiography by the Use of Gamma Rays. Robert F. Mehl, Gilbert E. Doan, and Charles S. Barrett (*Radiology*, 1931, 16, 508-535).—Read before the American Society for Steel Treating. See this *J.*, 1930, 44, 606.—S. G.

Principles of Industrial Testing with Gamma-Rays. R. Berthold and N. Riehl (*Z.V.d.I.*, 1932, 76, 401-406).—Comparative tests show that γ -rays are superior to X-rays in their power of penetration, and their low power of producing scattered radiation with consequent fogging; comparative curves are given. The most favoured source of γ -rays is radium emanation, although actual radium salts and mesothorium are also fully considered. The cost of a suitable installation is discussed. Applications of the method are described and illustrated, and the relative advantages and disadvantages of γ -ray and X-ray testing are summarized.—P. M. C. R.

Radiography by Gamma Rays. Anon. (*Metallurgist (Suppt. to Engineer)*, 1932, 8, 116-117).—A brief review of recent work on the subject, including that by Barrett and his collaborators, *Radiology*, 1931, 16, 461 and 508, and by Berthold and Riehl, *Z.V.d.I.*, 1932, 76, 401-406 (abstracts above).—R. G.

Inspection of Welds with Gamma Rays. Gilbert E. Doan (*Trans. Amer. Soc. Steel Treat.*, 1931-1932, 19, 752-758; discussion, 759-767).—See *J.*, this volume, p. 93.—S. G.

Gamma-Ray Testing of Welds. G. E. Doan (*Amer. Soc. Test. Mat. Symposium on Welding*, 1931, 106-112).—The small capsule of radioactive material which is used, is readily portable and can be placed in any awkward crevice of a large object. Up to 12 in. of steel can be readily examined. More than one weld may be examined at a time, the specimens being grouped round the source of rays, which are emitted in all directions.—H. W. G. H.

Inspection of Welding Made by the Watertown Arsenal. G. F. Jenks (*Amer. Soc. Test. Mat. Symposium on Welding*, 1931, 86-103).—X-ray inspection, which is standard practice at the Arsenal, is discussed. The faults which are detected by the method are described in relation to physical properties and micro- and macro-structure. The examples illustrated are all of ferrous materials. In resistance welds, X-rays will detect only the most crude defects.—H. W. G. H.

A Step Further in X-Ray. Herbert R. Isenburger (*Amer. Machinist (Eur. Edn.)*, 1932, 76, 133).—A single exposure to X-rays will readily reveal a defect, but not its location. For the latter, double exposure can be used. In this case, after the first exposure the article is moved over the film, say a distance a , and a second exposure taken. If h is the distance between the target and the film, b the distance between the two images of the defect, and x the space between the defect and the film, then $x = \frac{hb}{a+b}$, both the exact position of the defect and its seriousness being thereby determined.—J. H. W.

An X-Ray Chamber for Series Observations at High Temperatures. R. Berthold and H. Böhm (*Metallwirtschaft*, 1932, 11, 567-569).—A description is given of a Debye camera which can be used for specimens heated at temperatures up to 1500° C. *in vacuo* or in a gas in a small carbon tube furnace. The film can be changed in the camera, so that several exposures may be made without opening the camera.—v. G.

VIII.—PYROMETRY

(Continued from pp. 680-681.)

Use of Micropyrometer for High-Temperature Melting-Point Investigations. G. R. Fitterer and M. B. Royer (*U.S. Bur. Mines Rep. Invest. No. 3151*, 1932, 1-17; and *Met. Ind. (Lond.)*, 1932, 40, 521-524, 539-542).—The work described arose from the necessity of obtaining some knowledge of the melting points of various impurities—e.g. FeO, MnO, SiO₂, Al₂O₃, and their combinations—which occur in steel. A review is first given of the many definitions of melting point which have been advanced from time to time, and it is asserted that none of them is directly applicable to high melting point, possibly supercooled, materials. A definition of melting point for refractory materials is finally given by F. and R. as follows: "The melting point of an irregularly shaped refractory particle is that temperature at which the viscosity (or crystalline rigidity) is overcome by the random motion of the molecules, and at which the surface tension is sufficient to draw the particle into a globular shape." Other methods of measuring high temperatures not being suitable, resort was had to micropyrometric methods, based on Burgess' original work. An apparatus has been designed in which microscopic particles are melted on a thin platinum ribbon (for temperatures up to 1500° C.) or a molybdenum strip (for still higher ranges), in an atmosphere of pure nitrogen. The strip or ribbon is heated by a controlled electric current. A quartz window in the cap of the chamber enclosing the specimen provides an opening for measuring the temperature by radiation or optical means (normally by the Ardometer) and a low-power microscope, fixed at another point, enables the specimen to be observed during

heating. Calibration was undertaken by determining the fixed points for silver, gold, diopside, and palladium. The general procedure is examined and recorded in detail and a separate section is devoted to the precautions which have to be taken. A diagram of the apparatus is included. Reliable results have been obtained for a variety of silicates, oxides, and similar refractory materials. The accuracy of the method is decreased in the study of substances which have wide temperature ranges of solid-liquid immiscibility. Modifications in the apparatus have been made, so that the temperature is recorded automatically and the observer has only to note the signs of fusion. A full bibliography is appended.—W. A. C. N.

Some New Optical Pyrometers. Anon. (*Technique moderne*, 1930, 22, 708-709).—Describes with diagrams showing the construction, the Ardometer (Siemens); Pyrradio and Pyropto (Hartmann and Braun); Pyro and Optix (Pyrowerk).—H. W. G. H.

The Basic Principles of the Operation of Thermo-Electric Pyrometers. G. P. Kulbush (*Tepló i Sila (Heat and Power)*, 1927, (4-5), 44-51; (6), 1-6).—[In Russian.] The principles, apparatus, and applications of thermoelectric pyrometry are discussed.—N. A.

The Organization and Development of the Production of Galvanometers for Thermoelectric Pyrometers at the Kulakov Works in Leningrad. W. Voskresensky (*Tepló i Sila (Heat and Power)*, 1928, (3), 2-4).—[In Russian.] A general description is given of the development of the manufacture of pyrometers at the Kulakov Works in Leningrad.—N. A.

Temperature Measurements in Commercial Silicon Carbide Furnaces. Raymond R. Ridgway (*Trans. Electrochem. Soc.*, 1932, 61, 217-228).—See *J.*, this volume, p. 628, and following abstract.—S. G.

Discussion on R. R. Ridgway's Paper on "Temperature Measurements in Commercial Silicon Carbide Furnaces." E. Sprague. F. W. Brooke. N. A. Koehler. E. F. Northrup. O. Hutchins. M. E. Fogle. J. A. Boyer. R. R. Ridgway (*Trans. Electrochem. Soc.*, 1932, 61, 228-232).—Cf. preceding abstract. The temperature at which silicon carbide decomposes is greatly influenced by the concentration of the vapours of carbon, and depends on the concentration of the various gases in the furnace. Brooke mentions that silicon carbide parts last for vastly different periods according to the use to which they are put. Northrup is of the opinion that the most dependable final standard of high temperature is the brightness, under black-body conditions, of a pool of pure platinum just at the moment it starts to solidify. Bayer discusses the thermal changes and the variations in conductivity as the production of the carbide proceeds.—W. A. C. N.

Thermal Apparatus. Ezer Griffiths and W. H. Hatfield (*J. Sci. Instruments*, 1932, 9, 90-95).—Describes some of the exhibits at the Twenty-second Annual Exhibition of the Physical and Optical Societies. A new form of temperature regulator by the Royal Aircraft Establishment, Farnborough, is illustrated diagrammatically, and consists of a combination of levers which is periodically depressed, and opens or closes contacts according to the relative positions of the pointer and index mark; the figures must be consulted for details. Brief references are made to: (1) temperature-regulating equipment by the Cambridge Instrument Co. suitable for electric, gas, or oil-fired furnaces; (2) electrical resistance thermometers by Negretti and Zambra, and Elliott Bros. (London), Ltd.; (3) thermocouples and resistance thermometers for measuring surface temperatures, by the Cambridge Instrument Co., and the Foster Instrument Co.; (4) portable potentiometers by the Foster Instrument Co. for checking pyrometer installations *in situ*; (5) a thermostat by Egerton and Pidgeon (see *J.*, this volume, p. 242) for controlling the temperature of the cold junction of a thermocouple; (6) a direct-reading resistance thermometer outfit by E. Griffiths.—W. H.-R.

IX.—ELECTROMETALLURGY AND ELECTROCHEMISTRY

(Continued from pp. 681-684.)

ELECTRODEPOSITION

The Status of Chromium Plating. William Blum (*J. Franklin Inst.*, 1932, 213, 17-39; also (abstracts) *Found. Trade J.*, 1932, 46, 135, and *Machinery (N.Y.)*, 1932, 38, 930-931).—Without discussing actual details of the process, an excellent summary of the methods and applications of chromium plating is given. The physical and chemical properties of chromium plating are referred to at some length, and when dealing with probable future developments it is suggested that the advantages of chromium will lead to many new applications where resistance to wear and corrosion is required.—S. V. W.

The Electrodeposition of Chromium from Tervalent Chromium Salt Solutions. I.—Chromium Chloride and Chromium Sulphate Baths. Hubert Thomas Stanley Britton and Oliver Brentwood Westcott (*Trans. Faraday Soc.*, 1931, 27, 809-826; and (summary) *Metallurgist (Suppt. to Engineer)*, 1932, 8, 111-112; also (abstract) *Met. Ind. (Lond.)*, 1932, 40, 181; discussion, 181-182).—The effects of concentration, current density, temperature, addition of salts, and the use of a diaphragm between anode and cathode on the mechanical properties and purity of chromium deposits from neutral and basic chromic chloride and sulphate solutions have been investigated. At high p_H the deposits contain considerable amounts of basic material. At high current density from concentrated chromium salt solutions deposits containing more than 90% of chromium may be obtained, but their mechanical properties are poor.—A. R. P.

The Electrodeposition of Chromium from Tervalent Chromium Salt Solutions. II.—Chromium Acetate, Oxalate, and Tartrate Baths. Hubert Thomas Stanley Britton and Oliver Brentwood Westcott (*Trans. Faraday Soc.*, 1932, 28, 627-634).—Fairly good chromium deposits can be obtained from oxalate and tartrate baths containing a high concentration of chromium and alkali oxalate or tartrate provided that the p_H is kept high. Oxalate baths give better results than tartrate or acetate, and ammonium salts are better addition agents than sodium salts. Smooth bright deposits are obtained from ammonium chromioxalate baths, but even these contain more or less basic material according to the conditions of deposition. Current efficiency is very low, but is improved by using concentrated solutions and high current densities. Increase in temperature spoils the appearance of the deposits and increases their content of basic material.—A. R. P.

Lead and Lead-Antimony Anodes for Chromium Plating. E. M. Baker and P. J. Merkus (*Trans. Electrochem. Soc.*, 1932, 61, 327-333; also *Met. Ind. (N.Y.)*, 1932, 30, 272-274, and *Met. Ind. (Lond.)*, 1932, 41, 63-65).—See *J.*, this volume, p. 95, and following abstract.—S. G.

Discussion on E. M. Baker and P. J. Merkus' Paper on "Lead and Lead-Antimony Anodes for Chromium Plating." C. H. Eldridge. L. Weisberg and W. F. Greenwald. J. Schulein. C. G. Fink. E. M. Baker (*Trans. Electrochem. Soc.*, 1932, 61, 333-335).—Cf. preceding abstract. C. H. E. states that it is as a tank lining that antimonial lead shows the greatest superiority. If a much more concentrated solution, say 450 gm. per litre of chromic acid and 4.5 gm. per litre of sulphuric acid, be used, the corrosion-resistance of the antimony-lead is much more marked. He now uses a lead-tin alloy with 5-10% of tin and finds it much superior. Antimony is sometimes found by analysis in the solutions.—W. A. C. N.

Chromium Plating of Steel for Wear Resistance at High Temperatures and High Current Densities. A. Willink (*Trans. Electrochem. Soc.*, 1932, 61, 317-324).—See *J.*, this volume, p. 96, and following abstract.—S. G.

Discussion of A. Willink's Paper on "Chromium Plating of Steel for Wear Resistance at High Temperatures and High Current Densities." J. Schulein. C. G. Fink. E. M. Baker (*Trans. Electrochem. Soc.*, 1932, 61, 324-325).—Cf. preceding abstract. Plating on carburized steel at high current densities may cause trouble owing to the cracking of the base metal. At the high densities employed the time of plating may be reduced to one-fifth or one-tenth.—W. N.

A Bibliography of Chromium Plating. — Altmeyer (*Bull. Soc. Franç., Elect.*, 1930, [iv], 10, 1117-1130).—A list of papers dealing with chromium plating from 1920 to the beginning of 1930.—P. M. C. R.

Properties of Low p_H Nickel-Plating Baths. I.—Throwing Power, Cathode Current Efficiency, and Conductivity. L. C. Flowers and J. C. Warner (*Electrochem. Soc., Preprint*, 1932, Sept., 323-335).—Tests have been made at 25° and 52° C. and at p_H 1.9 and 5.3-5.6 on two solutions, having concentrations of nickel, chlorine, and boric acid of (a) 1, 0.25, and 0.25*N* and (b) 2.3, 0.25, and 0.75*N*, respectively. In the low p_H solutions there is a very marked increase and in the high p_H solutions a slight decrease in throwing power with increase in current density, but in all cases the throwing power tends to approach a common limiting value. Increase in the concentration of nickel and rise of temperature have little effect on the behaviour of high p_H baths, but both factors considerably improve the performance of low p_H baths. The current efficiencies of the baths closely follow the throwing power, but higher efficiencies are obtained in concentrated solutions, especially at low p_H . It is concluded that a concentrated nickel bath at high temperature and at low p_H is only slightly inferior in throwing power to the baths of high p_H generally used at present. The conductivity of all baths increases linearly with rise in temperature from 25° to 70° C., and is only very slightly affected by changing the p_H from 5.6 to 1.9.—A. R. P.

The Efficiency of Nickel Anodes. Albert Barattini (*Plating*, 1930, (13), 5-7).—Comparative tests have been made with cast and rolled nickel anodes over long periods in acid and neutral nickel-plating baths. Under similar conditions the percentages of waste ends, &c., were in a neutral bath 25% for the cast anode, 12% for the ordinary rolled anode, and 8% for a rolled anode, with a uniform grain structure and matt surface; in an acid bath the corresponding figures were 33, 24, and 15%, respectively.—A. R. P.

Nickel Anodes and Advances in Their Production. Anon. (*Metallwaren-Ind. u. Galvano-Tech.*, 1932, 30, 297-298).—The preparation, advantages, and disadvantages of various types of nickel anodes are discussed; hammered anodes are claimed to be the most satisfactory for all the usual nickel baths.—A. R. P.

Nickel Plating with Supply Current. V. Rubor (*Science et la Vie*, 1930, 37, 83).—A small nickel-, silver-, or gold-plating plant can be run from the local a.c. or d.c. electricity supply, a small transformer being needed in the former case. An adjustable resistance keeps the voltage down to the required level.—P. M. C. R.

Nickel Plating of Aluminium. M. Gasnier (*Plating*, 1930, (13), 13).—A brief review of methods of preparing the aluminium surface for the reception of a bright adherent coating of aluminium.—A. R. P.

Plant Practice for Nickel-Plating Aluminium. Andrew V. Re (*Trans. Electrochem. Soc.*, 1932, 61, 337-339).—See *J.*, this volume, p. 248, and following abstract.—S. G.

Discussion on A. V. Re's Paper on "Plant Practice for Nickel-Plating Aluminium." F. C. Frary. A. Willink. A. V. Re (*Trans. Electrochem. Soc.*, 1932, 61, 339-340).—Cf. preceding abstract. The bath has to be varied according to the type of alloy that is being treated. There is apparently no reason for putting on brass under the nickel. Nickel adheres more firmly on a properly etched aluminium surface than on any other metal. In the

preparation of the aluminium surface the chlorinated organic solvents appear to be satisfactory.—W. A. C. N.

The Chemical Control of Cyanide Silver-Plating Solutions. R. M. Wick (*Monthly Rev. Amer. Electroplaters' Soc.*, 1932, 19, (7), 5).—Summary of final and more complete paper published in *Bur. Stand. J. Research*, 1931, 7, 913-933; *Research Paper No. 384*. See *J.*, this volume, p. 46.—A. R. P.

Electro Tin Plating. R. E. Maeder (*Monthly Rev. Amer. Electroplaters' Soc.*, 1932, 19, (7), 12-16).—For tin-plating copper and brass refrigerators a solution containing 32 oz./gall. of sodium stannate and 1/32 oz./gall. of stannous chloride is recommended. When operated at about 65° C. with 4-8 v. and a current density of 15-45 amp./ft.², it yields dense deposits and has a high throwing power.—A. R. P.

Tin Plating of Cast-Iron Pistons. G. W. Glasson (*Monthly Rev. Amer. Electroplaters' Soc.*, 1932, 19, (7), 10-12).—This article was reproduced in *Brass World*, 1932, 28, 141. See *J.*, this volume, p. 633.—A. R. P.

Anodes for Zinc Plating. George B. Hogaboom and A. K. Graham (*Electrochem. Soc. Preprint*, 1932, Sept., 283-294).—In sulphate and in cyanide zinc-plating baths pure zinc anodes produce a large amount of anode sludge, the anode becomes covered with a black film, and the anode efficiency, especially in the sulphate baths, generally exceeds 100%, so that it is difficult to maintain a constant bath composition. In acid baths an anode containing 0.5% aluminium has better efficiency, is less attacked by the solution, and produces only a trace of sludge, whilst an anode containing 0.3-0.5% mercury is still less soluble in the solution and gives no sludge. In cyanide baths the mercury alloys give less polarization and a moderate amount of sludge, and the aluminium alloys give still less polarization and practically no sludge. The best anode for both types of bath is that containing 0.5% aluminium and 0.3% mercury. (Cf. Tammann and Neubert, *Z. anorg. Chem.*, 1931, 201, 225).—A. R. P.

Electrolytic Deposits on Aluminium and its Alloys. M. Ballay (*Technique moderne*, 1930, 22, 294-295).—Abstract of a paper read before the Académie des Sciences. See this *J.*, 1930, 43, 606; 1931, 47, 41 and 106.—H. W. G. H.

Hardness of Electrodeposited Coatings. L. K. Wright (*Machinery (N.Y.)*, 1930, 37, 288).—The best method of determining the hardness of such coatings is by means of a graded series of "scratch-pins," used in conjunction with a low-power lens.—H. F. G.

Easily Removable Electrodeposits. Richard Justh (*Oberflächentechnik*, 1932, 9, 57-58).—A review of recent patent processes for preventing adhesion of the electrodeposited metal to the cathode.—A. R. P.

Theory of Addition Agents. Seiji Kaneko (*Kōgyō Kwagaku Zasshi (J. Soc. Chem. Ind., Japan)*, 1931, 34, (3); *C. Abs.*, 1931, 25, 3889).—[In Japanese, with English summary in supplemental binding, p. 103.] (1) In crystallization from supersaturated solutions or deposition of metals by electrolysis, smaller crystals are obtained when the surface tension between the solids and liquid is small, because nuclei form more easily and copiously when the surface tension is smaller. (2) The solute, which is adsorbed positively on a solid from the solution, diminishes the surface tension between the solid and the liquid. Accordingly, smaller crystals are deposited from the solution of strongly adsorbing solute. (3) In electroplating, addition agents improve the deposition states because they weaken the surface tension and make the crystalline grains smaller.—S. G.

Cheaper Current for Plating Baths. Anon. (*Metallwaren-Ind. u. Galvano-Tech.*, 1932, 30, 277-278).—Electrical apparatus including a transformer and dry rectifier is described for taking current for plating baths direct from a.c. mains.—A. R. P.

Thermal Storage. Anon. (*Elect. Times*, 1930, 77, 1994; *Eng. Index*, 1930).—At the Skinnerburn works of the Northern Chromium Co. there is a total of

24 large tanks, which have been maintained at temperatures varying between 70° and 140° F. (21° and 60° C.) They include chromium-plating, sawdust, hot-water, and degreasing tanks, and various acid baths used for copper, nickel, and aluminium plating. Each tank is fitted with a heating coil made of steel or lead, depending on the nature of the electrolyte, and this coil is connected through valves to hot-water mains.—S. G.

ELECTROREFINING, &c.

Electrothermic Preparation of Aluminium. A. Paoloni (*Metallurgia italiana*, 1931, 23, 603-623; and (abstract) *Light Metals Research*, 1931, 1, (21), 12-14).—An account is given of the production of iron-silicon-aluminium and silicon-aluminium alloys by electrothermic methods. The alloy of aluminium 50, silicon 34% so made is the cheapest available source of aluminium and is used under the name "Alsimin" for deoxidizing steel. It is not economic to increase the aluminium content beyond 50%. The alloy is poured first into moulds, where it cools to 900° C., and is then turned into the final moulds, leaving behind a pasty mass of carbides. Hardeners for manufacturing Silumin have been successfully made with up to 70% aluminium by electrothermic methods. The carbon content can be reduced to 0.5% by a final refining process. It is considered that the industrial manufacture of electrothermic aluminium must remain an unsolved problem until the formation of carbides can be prevented.—J. C. C.

Bismuth Recovery from Copper. Walter Schopper (*Met. Ind. (Lond.)*, 1932, 41, 274).—Abstract from the *Metallgesellschaft Periodic Rev.*, 1932, (6), 29-30. See *J.*, this volume, p. 452.—J. H. W.

The Refining of Nickel. C. C. Downie (*Elect. Rev.*, 1932, 111, 282).—The problem of refining nickel by electrolysis is made difficult by the fact that both copper and iron, which are normal impurities in the unrefined metal, are deposited first. The application of superimposed a.c. offers a likely system of overcoming some of these difficulties. Some practical details obtained from the working of a large experimental plant are given.—S. V. W.

Selenium and Tellurium. S. Skowronski and M. A. Mosher (*Trans. Electrochem. Soc.*, 1932, 61, 113-121).—See *J.*, this volume, p. 636, and following abstract.—S. G.

Discussion of S. Skowronski and M. A. Mosher's Paper on "Selenium and Tellurium." E. W. Rouse. C. F. Burgess. P. H. Bracc. A. Willink. F. A. Lidbury. U. C. Tainton. F. F. Poland. C. G. Fink (*Trans. Electrochem. Soc.*, 1932, 61, 121-124).—Cf. preceding abstract. Modern selenium cells have comparatively little lag, but have a high temperature coeff. U. C. T. records that very small quantities of tellurium act as catalysts in the precipitation of cobalt from pure zinc solutions.—W. A. C. N.

Electrolyses in Melts of Phosphates. I.—The Electrolytic Production of α - and β -Tungsten. Hellmuth Hartmann, Fritz Ebert, and Otto Bretschneider (*Z. anorg. Chem.*, 1931, 198, 116-140).—Owing to their fusibility and high solvent power for tungstic acid, alkali phosphates make suitable electrolytes for the production of tungsten, but pure metaphosphate baths are unsuitable. Pure tungsten can readily be obtained by electrolysis of tungsten trioxide in a fused mixture of pyro- and meta-phosphates with sodium chloride at 650°-700° C. or in fused sodium pyrophosphate. The metal obtained consists of a mixture of the ordinary cubic body-centred tungsten and a new β -modification, also cubic, $a = 5.04$ Å. The elementary cell contains 8 atoms in the following positions: 000, $\frac{1}{2}\frac{1}{2}\frac{1}{2}$, $0\frac{1}{2}\frac{1}{2}$, $0\frac{1}{2}\frac{1}{2}$, $\frac{1}{2}0\frac{1}{2}$, $\frac{1}{2}0\frac{1}{2}$, $\frac{1}{2}\frac{1}{2}0$, $\frac{1}{2}\frac{1}{2}0$. At 650° C. β -tungsten is very slowly and irreversibly converted into the α -form. Above 650° C. only the α -form is deposited by electrolysis, and below 650° C. only the β -form. The density of tungsten depends on the grain-size.—B. Bl.

Contribution to Our Knowledge of the Principles of Technical Zinc Electrolysis. P. Röntgen and R. Buchkremer (*Abhandl. Inst. Metallhütt. u. Elektro-*

met. Tech. Hochschule, Aachen, 1932, [N.F.], 1, 6 pp.).—Reprinted from *Metallwirtschaft*, 1931, 10, 931-936. See *J.*, this volume, p. 372.—A. R. P.

Influence of Cobalt on Technical Zinc Electrolysis. P. Röntgen and R. Buchkremer (*Abhandl. Inst. Metallhütt. u. Elektromet. Tech. Hochschule, Aachen*, 1932, [N.F.], 1, 5 pp.).—Reprinted from *Metallwirtschaft*, 1931, 10, 963-967. See *J.*, this volume, 372.—A. R. P.

X.—INDUSTRIAL USES AND APPLICATIONS

(Continued from pp. 685-691.)

Friction of Some Babbitt, Roller, and Ball Bearings. Edward R. Maurer and L. A. F. Kelso (*Bull. Univ. Wisconsin, Eng. Exp. Sta. Series*, No. 72, 1931, 5-48).—The original and modified types of testing plant for carrying out a series of comparative running tests on commercial bearings are described, with illustrations. An appendix deals with the measurement of bearing temperature. The tests were undertaken to determine the friction of some types of bearing, in order to compare their frictional resistances. All types of bearing used are fully described. The Babbitt metal had the composition: lead 86.1, antimony 11.9, tin 2%. Complete graphical records are appended, including coeff. of friction for the 3 types of bearing at indicated loads and various speeds, rise of temperature of the 3 types of bearing under identical conditions, and ternary diagrams showing friction-speed-temperature surfaces for stated loads. The results point to the superiority of the ball bearing as regards low friction coeff. and heat evolution. Certain general conclusions from the results are given.—P. M. C. R.

The Adjustment and Alignment of Bearings. Anon. (*Lubrication*, 1931, 17, 77-84).—Causes of misalignment in shafting are analyzed, and methods of detecting and locating suspected errors are briefly indicated. Principles governing the assemblage of bearings are given. Liners between bearing surfaces should be of copper, brass, or paper; tin proves unsatisfactory in use. The use of lead wire in the preliminary adjustments is described. The questions of oil delivery and of correct grooving are discussed, and causes and methods of treatment of hot bearings and of hot rods are indicated. Certain limitations regarding the use of metallic packing are mentioned.—P. M. C. R.

Aluminium in Food. A Critical Examination of the Evidence Available as to the Toxicity of Aluminium. J. H. Burn (*Brit. N.-F. Metals Res. Assoc., Research Rep., External Series*, No. 162, 1932, 1-29).—The report deals first with experiments by official bodies, viz. the Prussian War Office and the U.S. Department of Agriculture, and then with investigations by individuals or bodies of individuals. The former both considered that aluminium was harmless and the latter comprise opinions on both sides. B. reviews the methods of the investigators and their conclusions and also considers the many rumours and much unsubstantiated evidence which have been made public. The final conclusion reached is that aluminium cooking vessels offer no danger to health.—H. W. G. H.

Aluminium Helpful to Health. Anon. (*Aluminium Broadcast*, 1931, 3, (8)).—A translation of a pamphlet issued by the German Aluminium Holloware Association.—J. C. C.

Strength of Modern Alloys is Selection Factor. F. V. Hartman (*Machine Design*, 1930, 2, (4), 22-26, 51; *Eng. Index*, 1930).—A description is given of machine parts cast by various processes, the advantages of which are outlined. Tables give the average mechanical properties of aluminium sand-casting alloys and factors applying to design stresses at elevated temperatures.—S. G.

What We Can Do [with Aluminium]. Anon. (*Aluminium Broadcast*, 1931, 3, (11), 3-9).—From a pamphlet issued by the London Aluminium Co., Ltd.—J. C.

- Aluminium in the Rayon Industry.** Anon. (*Textile Mercury*, 1930, 82, 212, 302; and (abstract) *Aluminium Broadcast*, 1930, 2, (24).—J. C. C.
- Aluminium Alloy Age Arrives for Truck Bodies.** Anon. (*Autobody*, 1930, April; and (abstract) *Aluminium Broadcast*, 1930, 2, (18).—J. C. C.
- Aluminium in the Motor-Cycle Industry.** W. Tyson (*Aluminium Broadcast*, 1932, 3, (26)).—Intelligence Memorandum No. 55 issued by the British Aluminium Co. Ltd., and reproduced in *Met. Ind. (Lond.)*, 1932, 40, 447. See *J.*, this volume, p. 374.—J. C. C.
- Aluminium Alloys in the Transportation Industry.** A. H. Woolen (*Proc. Western Railway Club*, 1930, 42, 20-32; *Eng. Index*, 1930).—Aluminium conduit is finding increased use for protecting wiring on locomotives, cars, shops, and engine-houses; it does not corrode under the conditions existing in these locations.—S. G.
- Railroad Use of Aluminium Alloys.** Anon. (*Railway Age*, 1930, 88, 377-380; *Eng. Index*, 1930).—A discussion held by the Western Railway Club indicates the economic advantages of aluminium alloys and their practicability from the fabrication point of view. The performance of aluminium in the Illinois Central Railway multiple-unit cars (capital investment returned in 4 years), the construction of aluminium cars, maintenance factors, aluminium tank cars and locomotive rods, and aluminium furniture are dealt with.—S. G.
- The New Light Cars of the Gerschnialp-Trübsee (Engelberg) Aerial Railway.** M. Hug (*Aluminium Broadcast*, 1932, 3, (29), 6-7).—Translated from *Schw. Bauzeit.*, 1932, 19, 124. See *J.*, this volume, p. 687.—J. C. C.
- Methods of Preserving Marine Turbines: Use of Aluminium Paint on the Blades.** H. Masseille (*Aluminium Broadcast*, 1931, 3, (12), 18-19).—Abridged translation from *Peintures, Pigments, Vernis*, 1931, 8, 1520-1522. See *J.*, this volume, p. 640.—S. G.
- Heat Enduring Metals for Furnace Construction [Calorizing].** B. J. Sayles (*Fuels and Furnaces*, 1930, 8, 699-701; *Eng. Index*, 1930).—Deals mainly with the calorizing process.—J. C. C.
- Use of Metals in Buildings Becoming Quite Common in Germany.** Anon. (*Daily Metal Reporter*, 1931, 31, (12), 4).—Abstracted from *Bull. Copper and Brass Res. Assoc.*, 1931, (62). See *J.*, this volume, p. 378.—P. M. C. R.
- Phosphor-Bronze—its Electrical Properties and Applications.** Wm. C. Hirsch (*Elect. Manufacturing*, 1931, 8, (Dec.), 30-32; *C. Abs.*, 1932, 26, 4021).—A description of the variation in composition of phosphor-bronze according to its uses in the electrical industry.—S. G.
- The Pre-Eminence of Gold.** L. Houllevigue (*Science et la Vie*, 1930, 37, 303-305).—An historical survey of the sources and use of gold, followed by an enumeration of its physical, chemical, and mechanical properties. Their influence on the popularity of gold and on its general adoption as a standard of value is discussed.—P. M. C. R.
- The Alloys of Magnesium in Aviation.** W. G. Harvey (*Technique moderne*, 1930, 22, 260).—Abstract of a paper read before the American Electrochemical Society. See this *J.*, 1930, 43, 631.—H. W. G. H.
- Electric Discharges in Mercury Vapour and their Control.** H. de B. Knight (*Rugby Eng. Soc. Proc.*, 1930-31, 25, (1), 23-62).—A survey of contemporary knowledge of the nature of and conditions governing the glow and arc discharges, with special reference to the prevention of backfiring in mercury arc power rectifiers, and to the working of the Thyatron.—P. M. C. R.
- Molybdenum.** Alice V. Petar (*U.S. Bur. Mines Econ. Paper No. 15*, 1932, 1-38; and (short abstract) *Met. Ind. (Lond.)*, 1932, 41, 130; *C. Abs.*, 1932, 26, 4015).—The properties, uses, occurrence, mining, milling, and manufacturing methods, foreign, and domestic production, markets, &c., for molybdenum are discussed. An extensive bibliography is given.—S. G.
- Magnetism and Magnetic Materials.** T. D. Yensen (*Elect. J.*, 1930, 27, 214-218; *Eng. Index*, 1930).—The steady improvement which electrical

apparatus has enjoyed from the beginning of the industry has been due largely to continuous improvement of magnetic materials. Y. gives notes on the early developments and possible improvements, and discusses the iron-nickel, iron-cobalt, and iron-nickel-cobalt alloys. A bibliography is given.—S. G.

A 4,000-Ampère Sodium Conductor. R. H. Boundy (*Met. Ind. (Lond.)*, 1932, 41, 351-353).—Abstract of a paper read before the Electrochemical Society. See *J.*, this volume, p. 569.—J. H. W.

The Evolution of Modern Printing and the Discovery of Movable Metal Type by the Chinese and Koreans in the Fourteenth Century. Judson Daland (*J. Franklin Inst.*, 1931, 212, 208-233).—A descriptive article on the subject which includes analyses of metal types used more than 500 years ago.—S. V. W.

Zinc and Cadmium in Chemistry and Pharmacy. I.—Historical. II.—The Metals and their Alloys. III.—Compounds of the Elements. G. Malcolm Dyson (*Pharm. J.*, 1932, 128, 163-164, 243-244, 308-309).—S. G.

Modern Materials and Material Problems in the Construction of Chemical Apparatus. — Kessner (*Chem. Fabrik*, 1931, 233-238, 250-252, 266-269; *C. Abs.*, 1931, 25, 3877).—Ferrous and non-ferrous metals and alloys, unprotected and protected by parkerizing, enamelling, &c., and also non-metallic materials are considered with respect to their resistance to chemical and mechanical agents and their workability. Various properties are shown in charts and photomicrographs.—S. G.

Metal Airships. W. Bleistein (*Z. Luft. u. Motor.*, 1930, 21, 626-630).—Abbreviated from a paper read before the Wissenschaftliche Gesellschaft für Luftfahrt. The greater weight of the metal airship is its principal disadvantage as against the use of fabric; the latter's great extensibility makes the maintenance of proper skin-tension difficult, and fabric, once penetrated, tears quickly and extensively. Metal airships are easily filled, easily repaired, and show low skin-friction, with decreased running cost; damage to the material does not spread quickly, and in any case is interrupted at the nearest seam. The penetrability by gas is lower, and the hygroscopic qualities are far less marked, than in the case of fabric.—P. M. C. R.

Metalclad Airships. Carl B. Fritsche (*South African Eng.*, 1931, 42, 180).—Abstract of a paper read before the American Society of Mechanical Engineers. See this *J.*, 1931, 47, 108.—P. M. C. R.

Insulating High-Tension Cable Joints. Anon. (*Power House*, 1929, 23, (5), 37).—A note on the Hochstadter method of insulation, in which a strip of metallized paper, wound over the paper insulation, acts as a condenser and serves to earth the cable in the event of a breakdown. The metallized paper is prepared by depositing aluminium electrolytically on paper. The outer covers include aluminium and copper tape separators for the cores, and a final lead sheath.—H. F. G.

Non-Ferrous Metals in the Automotive Industry. Francis A. Westbrook (*Met. Ind. (N.Y.)*, 1932, 30, 145-146).—A review of the different metals used in the construction of motor vehicles.—A. R. P.

XI.—HEAT-TREATMENT

(Continued from pp. 694-695.)

The Annealing and Tempering of Duralumin. Jean Matter (*Technique moderne*, 1930, 22, 732).—Abstract of a paper read at the 6e Congrès International des Mines, de la Métallurgie et de la Géologie Appliquée. See this *J.*, 1931, 47, 111 and 400.—H. W. G. H.

Adopting Modern Heat in the Brass Foundry. W. W. Young (*Met. Ind. (N.Y.)*, 1932, 30, 315-317).—The bright-annealing of brass and copper in gas-fired surface combustion furnaces is briefly discussed.—A. R. P.

Continuous Strip Annealing Process and Fundamentals of Heat Transfer in Continuous Strip Furnaces. O. Junker (*Metals and Alloys*, 1931, 2, 352-354; and adaptation) *Met. Ind. (Lond.)*, 1932, 41, 419-421, 430).—Translation of part of an article published in *Z. Metallkunde*, 1931, 23, 124-125. See this *J.*, 1931, 47, 614.—A. R. P.

The Grünewald Method of Bright-Annealing. R. W. Miller (*Iron and Steel Eng.*, 1930, 3, 181-183).—See this *J.*, 1930, 43, 643.—A. R. P.

XII.—JOINING

(Continued from pp. 695-700.)

Riveting Practice in Aero Construction. W. Pleines (*Z. Flug. u. Motor.*, 1930, 21, 282).—Review of an article in *Luftfahrtforschung*, 1930, 7, 1-72. See this *J.*, 1930, 44, 663.—P. M. C. R.

Brief Notes on the Autogenous Soldering of Metals with the Oxy-Acetylene Blowpipe. Joaquin Girart (*Afinidad*, 1931, 6, 295-301).—G. deals with the applications of oxy-acetylene autogenous soldering for repairs and fabrication and its advantages over riveting, &c., and describes the operation. Several kinds of soldering and cutting blowpipes are described and data are given with regard to gas and oxygen.—J. L. L. L.

Brazing Metals with Silver Solders. A. J. T. Eyles (*Elect. Rev.*, 1932, 110, 736).—Based on an article in *Mech. World*, 1932, 91, 5. See *J.*, this volume, p. 571.—S. V. W.

Welded Aluminium in Tank Trucks. W. M. Dunlap (*Welding Eng.*, 1931, 16, 35-36).—Abstract of a paper read before the International Acetylene Association, Chicago, Illinois, U.S.A. See *J.*, this volume, p. 500.—J. H. W.

Spot Welding Aluminium. W. A. Dunlap (*Welding Eng.*, 1929, 14, (12), 37-38).—Extract from a paper read before the Chicago Section of the American Welding Society. The metal electrode must not alloy the aluminium, and chromium-plated copper has been found to be satisfactory, chromium alone being too brittle. Round burner-tips are used and arc water cooled. Spot welds are about as strong as riveting, but are much cheaper. Aluminium alloys of one composition can be welded to aluminium alloys of another composition.—J. H. W.

Electric Arc Welding of Aluminium. Fred. J. Giroux (*Welding*, 1930, 1, 838-840).—S. G.

Electric Arc Welding of Aluminium. W. M. Dunlap (*J. Amer. Weld. Soc.*, 1930, 9, (10), 8-16; also (abstracts) *Welding Eng.*, 1931, 16, (4), 43-46; and *Metal Stampings*, 1930, 3, 922).—Details of the methods of welding aluminium are given and the requirements of a good weld are described. Proper manipulation of the arc and electrodes coated with a flux possessing certain essential qualities are necessary for success in the operation.—J. H. W.

Copper Welding Solves Refinery Problem. Anon. (*Mech. and Welding Eng.*, 1932, 7, 152-153).—See *J.*, this volume, p. 54.—H. W. G. H.

Oxy-Acetylene Welding of Sheet Copper. A. Eyles (*Sheet Metal Worker*, 1930, 21, 725-726).—S. G.

The Welding of German Silver. Anon. (*Mech. and Welding Eng.*, 1932, 7, 153-154).—From *Soudure et Oxy-Coupage*, 1932, 9, 131. See *J.*, this volume, p. 501.—H. W. G. H.

Welding Sheet Monel Metal. Anon. (*Indust. Gases*, 1932, 13, 63; and *Automotive Ind.*, 1932, 66, 591).—From *Oxy-Acetylene Tips*, 1932, 11, 45-46. See *J.*, this volume, p. 384.—H. W. G. H.

How to Weld Galvanized Iron. A. G. Wikoff (*J. Amer. Weld. Soc.*,

1930, 9, 23-27; discussion, 34-35; *Eng. Index*, 1930).—The welding of galvanized material results in the loss of a certain amount of zinc coating from the surface immediately adjacent to the welds. The welding of galvanized iron with steel welding rods is discussed. Experience seems to indicate that a welded joint in galvanized pipe is as good as a screw-coupled joint as far as internal corrosion is concerned. Bronze welded galvanized iron pipe, and the bronze welding of galvanized sheet are dealt with.—S. G.

Salvaging Expensive Parts. A. Eyles (*Welding Eng.*, 1930, 15, (5), 45-46; and *Canad. Mach.*, 1930, 41, (17), 74).—Oxy-acetylene welding is preferred for permanent repairs on aluminium products; the method is applicable in all such work, given proper cleaning, competent operators, and correct materials and equipment. The use of flux is important; it should be used sparingly in the form of a varnish on the welding rod, or painted on where rod is not used. Pure aluminium rod should be used for aluminium products, and a 5% silicon alloy for the strong light alloys. Corrosion is prevented by thoroughly cleaning the finished weld.—P. M. C. R.

Discussion of Paper by G. E. Thornton, Entitled "Giving the Weld a Chance." Charles H. Jennings (*J. Amer. Welding Soc.*, 1932, 11, (6), 10-11).—Cf. *J.*, this volume, p. 560. J. prefers the McAdam type cantilever specimen to the uniform strength specimen advocated by T. The latter is said to be difficult and costly to machine and to be subject to stress concentrations at the fillets. The McAdam specimen is free from stress concentration effects and has a length of more than 1 in. in which the stress variation is only 1%.
—H. W. G. H.

Autogenous Welding of Non-Ferrous Metals. Anon. (*Saldatura autogena*, 1932, 13, 81-90).—A review of the oxy-acetylene welding and brazing of copper, aluminium, and their alloys.—G. G.

Training Gas Welders for the Job. T. M. Jones (*Welding Eng.*, 1932, 17, (7), 33-39).—Read before the International Acetylene Association. See *J.*, this volume, p. 259.—H. W. G. H.

XIII.—WORKING

(Continued from pp. 701-705.)

The Measurement of the Surface Temperature of the Metal during the Drawing of Wire. F. C. Thompson and H. G. Dyson (*Metallurgia*, 1932, 6, 191-192).—A method of measuring the heat generated by metal when being drawn consists of forming a thermocouple of which the wire-die interface is the hot junction, and the room temperature the cold junction. The calibration of this thermocouple is described and also the procedure in carrying out the various measurements. Three series of measurements were made on brass wire, one using no lubricant, one with "oil-dag," and one in which the lubricant was a potassium-nut-oil soap. The influence of no, or of unsuitable, lubrication in increasing the temperature attained at the surface is marked. The temperature is distinctly greater at a speed of 16 ft. per minute for the unlubricated dies than it is at 50 ft. per minute when "oil-dag" is used, and soft soap occupies an intermediate position. These results are discussed in relation to the results of other investigators and are shown to be consistent.
—J. W. D.

Wire Forming Dies. Frank V. Keip (*Machinery (N.Y.)*, 1930, 37, 279-280).—A description, with drawings, of dies used for producing wire rings of both circular and irregular shapes.—H. F. G.

Applications of Electricity in Metallurgy. L. Galzin (*Technique moderne*, 1930, 22, 30-37).—Motors suitable for various types of rolling mills are described and their characteristics explained.—H. W. G. H.

Cannon Cartridge Manufacture. Mario Soto (*Memorial de Artilleria*, 1930, 10, 129-144).—Brasses are classified into 3 groups: those containing (1) 65-99.55% copper; (2) 55-65% copper, and (3) less than 55% copper. S. studies the malleability, brittleness (at different temperatures), effects of cold-work (prior to annealing), microstructure, and industrial uses (cannon cartridge cases, balls) of (1) and (2). The third group of brasses have no industrial applications, because of their brittleness. The brittleness of brasses and yellow metal is considered and S. proposes a modification of Grard's formula.

—J. L.

Dies for Deep-Drawing. Anon. (*Machinery (N.Y.)*, 1930, 37, 206-207).—Brief illustrated description of a die used for drawing shells of 15 in. or more in length.—H. F. G.

Designing Dies for Difficult Cup Forming. F. E. Shailor (*Machinery (N.Y.)*, 1930, 37, 86-88).—An illustrated description of the design of dies for drawing deep cups, and, particularly, of the design and applications of coning dies for thickening the walls of the shell at certain points.—H. F. G.

Important Points on Power Press Die Design. M. A. Lynch (*Machinery (N.Y.)*, 1930, 36, 778-779).—Abstract of a paper read before the Rugby Engineering Society. Deals with die clearance and relief, the oversize allowance to be made for shaving hard and soft brass blanks in order to obtain smooth clean edges, the minimum permissible distance between die openings, and the difficulties of taper drawing.—H. F. G.

Inverting Shells after They Leave the Hopper. J. E. Fenno (*Machinery (N.Y.)*, 1930, 37, 96).—Shells leaving the hopper are fed into recesses in the periphery of a disc or drum revolving on a horizontal axis, and are withdrawn automatically at a point diametrically opposite to the point of entry.—H. F. G.

Forming and Blanking Die for Radiator Fins. P. H. White (*Machinery (N.Y.)*, 1930, 37, 115).—See *J.*, this volume, p. 574.—H. F. G.

Die for Bending Circular-Shaped Clip. Donald A. Baker (*Machinery (N.Y.)*, 1930, 37, 281).—Description of a die used for producing the metal clips which are soldered on the ends of electric cables to serve as terminals. The metal used is half-hard brass.—H. F. G.

The Machine-Tools of Heavy Metallurgy. J. Seigle (*Technique moderne*, 1930, 22, 169-178, 237-243).—Describes machines for surfacing ingots; shears for cutting billets, plates, sheets, and sections; saws for hot- and cold-cutting; straightening rolls of various types; straightening and cutting machines for wire; journal-truing and buffing machines for heavy rolls.—H. W. G. H.

The Machinability of Brass and Bronze with Respect to the Lubrication and Cooling of the Turnings. K. Krekeler (*Z. ges. Giesserei-Praxis: Das Metall*, 1931, 52, 5).—Abstract of a paper read before the Fachausschuss für Werkstoffe im Verein Deutsche Ingenieure. The processes of working, sawing, milling, &c., of brass and bronze are not well understood. The cutting speeds in the case of these alloys are so great that the usual tools cannot stand up to them. For lubrication, an oil with a high cooling capacity must be used. The copper and brass may have a strong chemical affinity for the oil, which should be slightly saponaceous and resinous. A recommended viscosity is 2-3 at 50° C., and the flash-point should be at least 150° C. Various suitable lubricating oils are suggested and their effects on the metal turnings under various conditions are discussed.—J. H. W.

Continuous Drilling. Anon. (*Maschinenkonstrukteur*, 1931, 64, 98).—A multiple drilling, grinding, and threading machine is described. A roller conveyor and a movable bench make it possible for one operator to control the various processes and make the necessary adjustments.—P. M. C. R.

Equipment for Diamond-Boring Thin-Walled Tappet Guides. Anon. (*Machinery (N.Y.)*, 1930, 37, 34).—Details are given of a fixture for finish-boring concentric holes, 0.8122 in. \pm 0.0007 in. diam., in bronze bushings.
—H. F. G.

Boring with Tungsten Carbide Tools. J. B. Giern (*Machinery (N.Y.)*, 1930, 37, 175-178).—See *J.*, this volume, p. 577.—H. F. G.

Milling Practice for Limited Production. Anon. (*Machinery (N.Y.)*, 1930, 37, 250-251).—An account of methods applicable to production such as that of aircraft works, in which relatively few of each component are required and frequent changes in design occur. Operations on aluminium cylinder heads and carburettor heater bodies are illustrated and described.—H. F. G.

Our Experience with Tungsten Carbide Tools. J. B. Doan (*Machinery (N.Y.)*, 1930, 37, 6).—A note of results obtained at the works of the American Tool Works Co., Ohio, U.S.A.—H. F. G.

Tungsten Carbide in General Motors' Shops. Anon. (*Machinery (N.Y.)*, 1930, 37, 217-218).—A note of savings effected in the machining of metal, particularly aluminium and Babbitt metal. The need of removing strains in the tool shanks is emphasized.—H. F. G.

Tungsten Carbide in the Westinghouse Plant. J. M. Highducheck (*Machinery (N.Y.)*, 1930, 37, 259-261).—The brazing of tungsten carbide tips to steel shanks, and the subsequent grinding and lapping, are described in some detail. Silicon carbide and boron carbide, mixed to a paste with water, kerosene, lubricating oil, or olive oil, have been found economical for the rapid removal of tungsten carbide by lapping. Applications of such tools are outlined.—H. F. G.

XIV.—FINISHING

(Continued from pp. 705-708.)

[The Bullard-Dunn] Electrochemical Cleaning Process. Anon. (*Maschinenkonstrukteur*, 1931, 64, 111).—The Bullard-Dunn process for the removal of adherent oxides or scale from metallic surfaces is described. Hydrogen, set free by an electrolytic process, attacks and removes the oxides, and the clean metallic surface at once becomes coated with lead, which affords protection against etching, pitting, or hydrogen embrittlement, and which can subsequently be removed; the process can be modified to cover the removal of oil or grease. It is claimed that cleaning by this method affects normally inaccessible portions, does not appreciably alter measurements, and facilitates the detection of flaws; the lead coating may further serve, on account of its coherence and uniformity, as a useful undercoat for any subsequent plating process.—P. M. C. R.

Pickling Solution for Monel Metal. W. E. Warner (*Machinery (N.Y.)*, 1930, 37, 47).—The bath recommended contains 1.7 lb. commercial sulphuric acid, 0.7 lb. sodium chloride, 0.6 lb. sodium nitrate, and 1 gall. water; if very heavy scale is present, 1% concentrated nitric acid may be added. The bath should be used at 80° F. (27° C.).—H. F. G.

Degreasing in Chromium-Plating Technique. Richard Justh (*Oberflächentechnik*, 1932, 9, 3-4).—See abstract from another source, *J.*, this volume, p. 192.—A. R. P.

Degreasing Metal Parts. Hans Heberling (*Oberflächentechnik*, 1932, 9, 33-35).—See abstract from another source, *J.*, this volume, p. 504.—A. R. P.

Artificial Corrosion of Japanese Special Alloys. Denzo Uno (*Abhandl. Inst. Metallhütt. u. Elektromet. Tech. Hochschule, Aachen*, 1932, [N.F.], 1, 20 pp.).—Reprinted from *Korrosion u. Metallschutz*, 1929, 5, 121-130, 147-156 (see this *J.*, 1930, 43, 670).—A. R. P.

Affinity and Cutting Capacity. W. Guertler (*Z. Metallkunde*, 1932, 24, 229-230; discussion, 230).—If two solid elements having a chemical affinity for one another are ground together, a chemical compound is formed, thus copper sulphide, silver sulphide, iron phosphide, &c. are obtained when copper, silver, or iron are ground with sulphur or phosphorus. The formation of Mg₂Pb can also be detected when lead is polished with magnesium. These results are of importance in the study of the processes of cutting, wear, and friction.—M. H.

The Fundamentals of Machine Polishing. Robert T. Kent (*Machinery* (N.Y.), 1930, 37, 129-130, 202-203).—For polishing aluminium, Duralumin, and copper, Turkish emery is recommended, whilst for brass Alundum is satisfactory. Practical notes are given on the selection of wheels, abrasives, polishing speeds, and work-holding fixtures. Means of eliminating vibration, methods of holding articles to be polished, and typical polishing machines are also described.—H. F. G.

Tools for Burnishing. Alf Schroeder (*Maschinenbau*, 1932, 11, 339-343).—New German machines for turning and boring very smooth surfaces and for burnishing them are described.—v. G.

XV.—FOUNDRY PRACTICE AND APPLIANCES

(Continued from pp. 708-713.)

Ferrous and Non-Ferrous Metals in the Foundry. W. Rosenhain (*Foundry Trade J.*, 1932, 46, 354-356, 358; and *Met. Ind.* (Lond.), 1932, 40, 618-619, 638-640).—Read before the Institute of British Foundrymen. Many of the differences between ferrous and non-ferrous foundry practice are traceable to the high melting point of the former materials as compared with most of the latter. The high cost of melting, combined with the cheapness of the material, caused ferrous workers to concentrate on fuel economy and simple furnace construction rather than on quality of output; the great susceptibility of molten ferrous materials to chilling introduced a special set of moulding problems. In non-ferrous founding, waste of material was far more carefully checked, and innovations in melting practice were more readily undertaken, and, especially as regards electric melting, this branch of the industry is far in advance of ferrous practice. There is much room for mutual investigation of the qualities of moulding sands, and the questions of "flaming" dressings and core binders. The pouring qualities of molten metals involve such considerations as pouring methods, surface oxidation, gates and risers, and the absorption and evolution of gases. A possible extension of die-casting to the ferrous field is discussed. The demand for corrosion-resistant materials must result in adaptations of technique, either for new alloys or for improved castings intended for plating or some other protective process. Forged material is here a serious rival. Methods of inspection, sampling, and testing of castings are reviewed; an extension of X-ray testing appears desirable. Some striking differences between ferrous and non-ferrous testing specifications are discussed.—P. M. C. R.

The Laboratory and the Foundry. R. Arzens (*Proc. Inst. Brit. Found.*, 1930-1931, 24, 230-235; discussion, 235-238; and *Foundry Trade J.*, 1931, 44, 413-414).—A number of the duties of the foundry metallurgist is indicated, and stress is laid on the value of his co-operation with the practical executives.—J. H. W.

An Indian State Railway Foundry. C. A. Howe (*Proc. Inst. Brit. Found.*, 1930-1931, 24, 399-419; and *Foundry Trade J.*, 1931, 44, 85-88).—A description of a large iron and brass foundry of the Great Indian Peninsula Railway Company at Bombay.—J. H. W.

A Method for the Study of Shrinkage and its Distribution in Castings. N. B. Pilling and T. E. Kihlgren (*Trans. Amer. Found. Assoc.*, 1932, 40, 201-212; discussion, 213-216).—The authors consider that the significant shrinkage constants are: (1) change of volume accompanying solidification; (2) discrepancy between pattern and casting dimensions. Given a simple type of mould of known and reproducible volume, adequately vented, and with effectively choked gate, they describe the determination of the shrinkage coeff., or percentage decrease in volume from casting to room temperature. All melts are cast at the freezing point of the material to eliminate liquid shrinkage. The shrinkage coeff. S is calculated from the equation $S = 100 \frac{v}{V} = 100 \left(1 - \frac{w}{Vd}\right)$,

where V = mould volume, v = total shrinkage in volume to room temperature, w = weight of unfed casting, d = density of metal at room temperature, and $V^1 = \frac{w}{d}$ = volume of metal at room temperature; the value v is obtained from $V - V^1$. Shrinkage distribution is studied by a fully described technique of macro-examination and printing. Figures obtained show satisfactory agreement with those obtained by the (U.S.) Bureau of Standards.—P. M. C. R.

Tentative [Suggestions] for a Systematic Classification of Foundry Defects. C. Gierdziejewski (*Internat. Found. Congress, Milan, Memoirs, 1931, 473-481*).—[In French.] The nature and causes of foundry defects are examined, the necessity of a reduction of external and surface defects, at the expense of internal defects, is stressed, and the various defects are classified as follows: defects of dimensions; surface defects; defects produced by the introduction of impurities from the sand; defects caused by interruption of pouring and pieces not joined; shrinkage pipes and blowholes; cracks and fissures; defects due to dross inclusions; segregation faults; defects in the metal. The causes of the defects are classified under the following heads: design; patterns and moulds; moulding sand; moulding and core-making; drying of moulds; setting up of moulds; melting; pouring; composition of the metal; various.—G. G.

Foundry Factors and Defects (Metallography and the Foundry). A. Portevin (*Internat. Found. Congress, Milan, Memoirs, 1931, 545-553*).—[In French.] The importance of metallographic methods in the foundry is stressed, and it is pointed out that the properties of a test-piece, as determined apart from the casting, do not solve all the problems of the foundrymen, e.g., the piece must have its shape and dimensions exactly fixed ("castability" and shrinkage are therefore of great importance); it must be homogeneous and free from defects or segregation.—G. G.

On the Formation of Blowholes and Pores in Castings. E. Scheuer (*Light Metals Research, 1932, 2, (10), 6-11*).—Translated in full from *Metallwirtschaft, 1931, 10, 947-951*. See *J.*, this volume, p. 389.—J. C. C.

Deoxidation of Metals in the Foundry. R. Berger (*Found. Trade J.*, 1932, 47, 114).—Abstract of an article in *Z. ges. Giesserei-Praxis: Das Metall, 1932, 53, 144-145*. See *J.*, this volume, p. 506.—J. H. W.

The Improvement of Products and the Reduction of Costs of Manufacture in the Foundry. E. Ronceray (*Internat. Found. Congress, Milan, Memoirs, 1931, 581-586*).—[In French.] The importance of systematic research and control in the foundry is emphasized and some lines along which improvements may be made are put forward.—G. G.

Water-Cooled Ingot Moulds—Construction, Uses, Results. H. Scherzer (*Internat. Found. Congress, Milan, Memoirs, 1931, 609-618*).—[In French.] The numerous defects of massive ingot moulds for casting brass are eliminated in the Junker water-cooled ingot mould, which is used extensively on the Continent. This mould is also suitable for casting copper, nickel-brass, nickel

and cupro-nickel, Duralumin, and precious metals. It is very easy to handle, and castings may be made in the same mould every 5-10 minutes.—G. G.

A Survey of Light Castings Manufacture. F. Harris (*Proc. Inst. Brit. Found.*, 1930-1931, **24**, 506-522; and *Foundry Trade J.*, 1931, **44**, 107-109).—Details of charging, melting, preparation of facing sands, pattern plate-making, mould preparation, and moulding for the production of light metal castings are given. The chief troubles arise from the necessity of obtaining castings possessing a smooth, clear skin.—J. H. W.

Refining of Aluminium and its Alloys by Treatment with Chlorine and Nitrogen. W. Koch (*Abhandl. Inst. Metallhütt. u. Elektromet. Tech. Hochschule, Aachen*, 1932, [N.F.], **1**, 7 pp.).—Reprinted from *Metallwirtschaft*, 1931, **10**, 69-72, 85-88 (see this *J.*, 1931, **47**, 237).—A. R. P.

The Influence of Melting Conditions on the Occlusion of Gas by Aluminium Alloys. Kokichi Ito (*Kinzoku no Kenkyu*, 1932, **9**, (7), 296-304).—[In Japanese.] The influence of variations in melting conditions on the amount of gas occluded or the presence of blowholes in castings of aluminium alloys, e.g. "LS," "Y," Duralumin, Silumin, and the alloy containing copper 4 and silicon 8%, has been investigated by measurements of sp. gr. It was found that melting at high temperatures leads to increase of the amount of gas, but that the influence of melting time is comparatively small. The method of maintaining the melt at a temperature just above the liquidus prior to casting has a decidedly advantageous effect, and practically sound castings are obtainable by this method. Fluxes have been tried, with successful results; $ZnCl_2$ is effective in removing pinholes, especially with "Y" alloy. Treatment with nitrogen gas has been less successful, whilst chlorine treatment appears to be distinctly effective.—S. G.

The Production of an Aluminium Alloy Casting. A. Harley (*Proc. Inst. Brit. Found.*, 1930-1931, **24**, 420-430; discussion, 430-434).—See this *J.*, 1931, **47**, 238.—S. G.

Remarks on the Casting of Motor Pistons. R. Fischer (*Giesserei*, 1931, **18**, 301-303; and (abstract) *Fonderie mod.*, 1931, **25**, 379-380).—A satisfactory piston material should combine lightness, freedom from tendency to seize, a low coeff. of thermal expansion, a high thermal conductivity, and a good resistance to wear. On this basis the merits of cast iron, aluminium, aluminium-copper, aluminium-silicon, and Elektron are considered. Modifications of casting methods are discussed; forms of mould for die-cast pistons of various materials are described and illustrated. Types of piston-ring and methods of insertion are discussed.—P. M. C. R.

Permanent Mould Casting of Aluminium Alloys. J. B. Nealey (*Machinery (N. Y.)*, 1930, **37**, 100-102).—The methods described are those employed at the works of the Monarch Aluminium Ware Co., Detroit, U.S.A., for the production of a great variety of articles. The alloys used are principally aluminium 92, copper 8%; aluminium 95, silicon 5%, or more complex types. Gas heating has been found the most economical, and is employed for cylindrical oscillating melting furnaces of 2000 lb. capacity. Gas-fired furnaces are used also for annealing and heat-treating alloy castings. Semi-steel castings are employed for the moulds.—H. F. G.

The Deoxidation of Copper with the Metallic Deoxidizers Calcium, Zinc, Beryllium, Barium, Strontium, and Lithium. Earle E. Schumacher and W. C. Ellis (*Trans. Electrochem. Soc.*, 1932, **61**, 91-99).—See *J.*, this volume, p. 580, and following abstract.—S. G.

Discussion on E. E. Schumacher and W. C. Ellis' Paper on "The Deoxidation of Copper with the Metallic Deoxidizers Calcium, Zinc, Beryllium, Barium, Strontium, and Lithium. L. Addicks. E. W. Rouse, Jr. P. E. Landolt. F. F. Poland. E. E. Schumacher and W. C. Ellis (*Trans. Electrochem. Soc.*, 1932, **61**, 99-100).—Cf. preceding abstract. Rouse confirms that oxygen-free

high-conductivity copper is excellent in quality, showing high ductility. Landolt cites a case of deoxidation by less than 0.03% of lithium. Oxygen-bearing copper when annealed at 800° C. showed a decrease in conductivity; deoxidized samples did not exhibit this.—W. A. C. N.

The Melting of Copper. G. Dubercet (*Fonderie mod.*, 1932, 26, 281).—Taken from an article in *Z. ges. Giesserei-Praxis: Das Metall*, 1932, 53, 12–13. See *J.*, this volume, p. 264.—J. H. W.

Remelting Copper Scrap. G. Dubercet (*Fonderie mod.*, 1932, 26, 297–298).—Taken from *Z. ges. Giesserei-Praxis: Das Metall*, 1932, 53, 48–49. See *J.*, this volume, p. 264.—J. H. W.

Casting Properties of Nickel-Bronzes. N. B. Pilling and T. E. Kihlgren (*Trans. Amer. Found. Assoc.*, 1932, 40, 289–305; discussion, 305–309).—The effect of additions of nickel not exceeding 3% on the casting properties of certain bronzes and brasses is discussed. The melting point of bronze is raised by introducing nickel, and a series of liquidus temperatures is given for various compositions. No appreciable effect on the freezing range is noticed. Increasing fluidity with nickel additions renders it possible to pour at a lower temperature; some fluidity tests are described, and the results tabulated. Nickel produces a remarkable refinement of grain-size, and its effects on several alloys of stated composition are given for varying pouring temperatures. Refinement is greatest at low temperatures, where it often amounts to 60%. The influence on piping of nickel additions is small, but small dispersed pores are fewer and the area of unsoundness is diminished. In the discussion, the beneficial effects of nickel in preventing "lead sweat" and in combating corrosion are emphasized.—P. M. C. R.

The Moulding and Casting of Bronze Plates. R. Liddle (*Proc. Inst. Brit. Found.*, 1930–1931, 24, 351–367; discussion, 367–372).—See this *J.*, 1931, 47, 52.—S. G.

Green-Sand Casting of a Large Bronze Plate. Anon. (*Fonderie mod.*, 1932, 26, 262–264).—Taken from an article in *Z. ges. Giesserei-Praxis: Das Metall*, 1931, 52, 114–116. See *J.*, this volume, p. 127.—J. H. W.

Preparation and Mechanical Properties of Castings of Bronze and Brass.—Schmidt (*Z. ges. Giesserei-Praxis: Das Metall*, 1931, 52, 3–4; discussion, 4).—Abstract of a paper read before the Fachausschuss für Werkstoffe im Verein Deutsche Ingenieure. Bronzes are essentially copper-tin alloys of high copper content. Owing to the high price of tin, part of this constituent is sometimes replaced by zinc or lead. Phosphorus is used to deoxidize the metal, and since phosphoric acid may be retained by the surface of the metal, forming a ternary copper-tin-phosphorus alloy, the phosphorus content must not exceed 1%. The effect of both metallic and non-metallic impurities is not very great. Owing to the temperature gradient between the outer and the inner portions of bronze castings, internal strains may be set up, leading to plastic deformation and to an effect on the shrinkage of the castings. During chilling, chemical reaction may occur and cause alteration in volume. The formation of cavities is reduced by making the melt more fluid.—J. H. W.

On the Cooling of Ingots in Chill Moulds, Especially Brass Ingots in Water-Cooled Moulds. Walther Roth (*Abhandl. Inst. Metallhütt. u. Elektromet. Tech. Hochschule, Aachen*, 1932, [N.F.], 1, 21 pp.).—Simple equations are derived for calculating the temperature changes during the cooling of metal ingots in water-cooled moulds; these take into account the temperature differences in the ingot, the rate of cooling, the time taken by the ingot to solidify, and the temperature gradient in the mould walls. The resistance to heat transfer, which is of importance in these calculations, has been determined in the case of brass ingots, and it is shown that the heat transfer through the mould dressing, which opposes by far the greatest resistance to the dissipation of heat, cannot be controlled scientifically. By suitable selection of the material and thickness

of the walls of water-cooled moulds the rate of cooling of brass ingots may be varied by about 50% and by variations in the rate of flow of water by 15%. With a rapid rate of cooling, 70 : 30 brass solidifies at a constant temperature, and not through a temperature range, as would be expected from the equilibrium diagram. From this fact and from measurements of the amount of segregation which occurs in slowly-cooled ingots it is concluded that 70 : 30 brass segregates only slightly on solidification. The grain-size and transcrystallization of cast brass depend chiefly on the casting temperature and rate of cooling, but as the latter can be varied only within narrow limits in chill castings, the casting temperature has by far the greatest effect.—A. R. P.

Defects in Brass Castings. Anon. (*Fonderie mod.*, 1932, 26, 243-244, 252-253).—Taken from an article in *Z. ges. Giesserei-Praxis: Das Metall*, 1931, 52, 113-114, 117-118. See *J.*, this volume, p. 196.—J. H. W.

Remelting Old Brass in the Reverberatory Furnace. G. Duberect (*Fonderie mod.*, 1932, 26, 272-275).—Abstract of an article by E. T. Richards in *Giesserei*, 1932, 19, 5-9. See *J.*, this volume, p. 390.—J. H. W.

Phosphorus in Red Brass. R. W. Parsons (*Trans. Amer. Found. Assoc.*, 1932, 40, 47-56; discussion, 57-62; and (abstract) *Met. Ind. (Lond.)*, 1932, 41, 79-81).—P. describes a series of casting tests made on a valve brass of nominal composition copper 81.5, tin 3, lead 7, and zinc 8.5%, with the primary object of eliminating leakage failures due to green (oxide?) inclusions. A small indirect are furnace with reducing atmosphere was used. P. concludes that: (1) castings made from new metal were greatly inferior to those made from remelted material; (2) the addition of 0.1% phosphor-copper to the heat eliminated all but 1% of the failures both with new metal and scrap; (3) excess phosphorus (0.2% phosphor-copper) caused "wildness" and attack on the ladle lining, with consequent dirt inclusions in the castings; (4) "wildness" was eliminated by lowering the pouring temperature. Phosphor-copper should be added to the melt not more than five minutes before pouring; half the total addition should be made thus, the remainder being added in the ladle. The copper would appear to be the principal source of oxygen in the melt. In the discussion, *H. M. St. John* considers the use and functions of barium sulphate in furnaces of reducing atmosphere, and emphasizes the uselessness of residual phosphorus as a deoxidizer on remelting. Methods of sampling the melt are discussed by *W. M. Ball* and *C. H. Morken*. The "wildness" produced by excessive phosphorus additions was considered, and an opinion expressed that in certain types of foundry work phosphorus is actually harmful. (Cf. following abstracts.)—P. M. C. R.

Phosphorus in Red Brass. Edmund Richard Thews (*Met. Ind. (Lond.)*, 1932, 41, 317-318, 322).—The question as to whether phosphorus in red brass reduces the tin and zinc oxides or only increases the fluidity of the metal is discussed in favour of the latter view. The arguments are based largely on the results of experiments published by R. W. Parsons (preceding abstract) on an alloy of copper 81.5, tin 3, lead 7, and zinc 8.5%, with the addition of phosphor-copper as a deoxidizer.—J. H. W.

Phosphorus in Red Brass. G. L. Bailey (*Met. Ind. (Lond.)*, 1932, 41, 344).—A letter discussing and criticizing statements made by E. R. Thews (see preceding abstract). It is stated that while less than 0.04% phosphorus will enable brass ingots to be cast exposed to air without the formation of oxide skin on the ingot surface, 0.2% of phosphorus will not prevent surface oxidation of brass containing 0.2% of aluminium. This fact does not confirm T.'s hypothesis.—J. H. W.

Phosphorus in Red Brass. C. C. Hodgson (*Met. Ind. (Lond.)*, 1932, 41, 392-393).—Continuing the discussion by G. L. Bailey (see preceding abstract) of a paper by E. R. Thews (abstract above), and giving examples of the co-existence of phosphorus and oxides in brass and gunmetal. Certain inclusions

were found when poor-quality scrap was used for making these alloys, and were not removed by phosphorus, which, however, imparted free-running properties to the metal. The addition of phosphorus to brass containing aluminium is stated to be useless. The different action of phosphorus in various cases is suggested as being due to its differing effect on the interfacial tensions between the liquid metal and the various oxides.—J. H. W.

Simplification in the Manufacture of Special Brasses. G. Dubercet (*Fonderie mod.*, 1932, 26, 384-385; and (abstract) *Found. Trade J.*, 1932, 47, 299).—Taken from an article by A. le Thomas in *Rev. Mét.*, 1931, 28, 518-523. See *J.*, this volume, p. 15.—J. H. W.

American Standards for Foundry Products. O. Schlievinsky (*Giesserei*, 1930, 17, 139-142; *Eng. Index*, 1930).—Discusses the specifications for bronze, "aluminium-bronze," "manganese-bronze," and brass castings, issued by the American Federal Specifications Board; their effectiveness in practice is subjected to constant close observation and, when necessary, revised standards are issued.—S. G.

White Bearing Metals. Ernst Fleischmann (*Forschungsarb. Metallkunde u. Röntgenmetallographie*, 1932, 3, 1-89).—Methods of melting, casting, and testing bearing metals are critically reviewed and various improvements suggested. New casting and testing machines are also described. To obtain satisfactory bearings thorough cleanliness and efficient tinning of the seating are essential; the casting should remain liquid for at least 1 minute and for not more than 5 minutes. Photomicrographs of the structure of the most important bearing metals are reproduced, and the effects of grain-size and inclusions on the physical and mechanical properties are discussed. Numerous curves showing the behaviour of bearing metals during use are included, and methods are given for the complete analysis of all types of bearing metal.—A. R. P.

Designing for Aluminium Die-Castings. D. B. Hobbs (*Production Eng.*, 1930, 1, 60-62; *Eng. Index*, 1930).—The die-casting process consists in forcing molten metal under considerable pressure into steel dies. The main characteristics of die-castings, their extreme accuracy, uniformity, and superior finish are the result not only of the method by which the castings are made, but also of the fine art developed in the construction of dies. The fact that aluminium alloys have a higher melting point than lead, tin, and zinc alloys required the development of special alloy steel dies. A general description is given of the casting process.—S. G.

[**Die-Cast Aluminium Rotors.**] Anon. (*Machinery (N. Y.)*, 1930, 37, 257).—Brief reference to the die-casting of small (up to 10×10 in.) electric rotors in aluminium at the rate of 30 per hr.—H. F. G.

Aluminium Pressure Die-Casting Machine. Anon. (*Machinery (Lond.)*, 1932, 39, 791-792).—The same article was published in *Mech. World*, 1932, 91, 10. See *J.*, this volume, p. 712.—J. C. C.

Zinc Die-Castings. Al : Cu : Mg, 4 : 3 : 0.1%. W. M. Pierce and Marc Stern (*Metal Progress*, 1931, 20, (6), 53-58).—Prepared for the Non-Ferrous Data Sheet Committee of the (American) Institute of Metals Division of the American Institute of Mining and Metallurgical Engineers and the Recommended Practice Committee of the American Society for Steel Treating. The low price of zinc recommends its use as a principal ingredient in die-castings; with careful selection of alloy composition great accuracy of dimensions can be combined with strength and soundness, and the product is adapted for plating or other special finishes. A favoured range of composition is: aluminium $4 \pm 0.5\%$; copper $3 \pm 0.5\%$; magnesium 0.02-0.12%; remainder zinc, with maximum impurities 0.02%. Maximum contents of lead, cadmium, iron, and tin are specified. The functions of each ingredient are indicated. The influence on mechanical properties of casting conditions and design;

specifications for test-pieces, and the effects of ageing tests are discussed. A full test of minimum physical and mechanical requirements is given, with recommendations for machining, drilling, and protection.—P. M. C. R.

Modern Die-Casting Technique. Otto Lich (*Maschinenkonstrukteur*, 1931, 64, 114–117).—Various forms of hand- and pneumatically operated die-casting machinery are described and illustrated, with special attention to the making of light alloy castings and to the minimizing of the solvent action of such alloys on moulds. Types of mould are described, and examples of complex castings in Silumin and other materials are illustrated.—P. M. C. R.

Die-Casting. J. H. Westwood (*Proc. Inst. Brit. Found.*, 1930–1931, 24, 660–669).—See this *J.*, 1931, 47, 458.—S. G.

Design of Automatic Die-Casting Dies. Charles O. Herb (*Machinery (N.Y.)*, 1930, 36, 665–671; 37, 40–43, 109–112).—See *J.*, this volume, pp. 267, 391.—H. F. G.

Pattern-Making and its Relations to Design and Foundry Practice. Matthew Russell (*Proc. Inst. Brit. Found.*, 1930–1931, 24, 578–591; discussion, 591–596; and *Foundry Trade J.*, 1931, 44, 253–256).—The various operations and devices used in pattern-making are described, and the importance of design on satisfactory casting is emphasized. In the discussion and reply, the advantages of the use of these devices in the competition of casting with welding are outlined.—J. H. W.

An Investigation of the Suitability of Soya-Bean Oil for Core Oil. Carl H. Casberg and Carl E. Schubert (*Univ. Illinois Bull.*, 1931, 29, (Eng. Exper. Sta. Bull. No. 235), 5–22).—Raw soya-bean oil produces cores with an average tensile strength which compares favourably with that of cores made with the usual oils, and is higher than that of cores made from semi-refined or varnish soya-bean oil. The most favourable baking time is 1 hr., shorter or longer periods leading to loss in strength. Addition of kerosene reduces, and addition of Japan drier slightly increases, the strength of cores bonded with soya-bean oil. Mixtures of linseed oil and soya-bean oil are as good binders as linseed oil alone.—A. R. P.

Investigation of Endurance of Bond Strength of Various Clays in Moulding Sand. Carl H. Casberg and William H. Spencer (*Univ. Illinois Bull.*, 1929, 27, (Eng. Exper. Sta. Bull. No. 200), 1–28).—The investigation on nine varieties of clay had as purpose the determination of their physical and chemical properties, the comparison of their bond strengths, thermal conductivities, and degrees of deterioration under heat and in use, and the measurement of the comparative permeabilities of moulding sands and of the effect on these of repeated heating. Methods of temperature measurement, fineness and endurance testing, and measuring thermal conductivity and permeability are described, and comparative tables of results are given. Among the principal conclusions are the following: (1) abnormal losses of bond strength on first heating are related to the acidity or alkalinity of the clays; (2) the original bond strength of a clay determines that of the moulding sand in which it is used; (3) the quotient, % loss of bond strength ÷ original bond strength, is a constant for any given set of conditions; (4) the shell affected by contact with a casting has approximately the same thickness for any sand.—P. M. C. R.

Some Practical Notes on Foundry Sands. J. L. Francis (*Proc. Inst. Brit. Found.*, 1930–1931, 24, 312–339; discussion, 339–350; and *Foundry Trade J.*, 1930, 43, 281–284, 293).—The essential physical properties of foundry sands are outlined, and the preparation and blending of the sands are described. The misuse, control, and testing of sands are discussed and, in the discussion and reply, further factors regarding the preparation and use of various sands and of coal-dust are given.—J. H. W.

Sands and Sand Testing. J. G. A. Skerl (*Proc. Inst. Brit. Found.*, 1930–1931, 24, 151–203; discussion, 203–208).—See this *J.*, 1931, 47, 609).—S. G.

Sand Tests in the Foundry. John Hird (*Proc. Inst. Brit. Found.*, 1930-1931, 24, 536-553; and *Foundry Trade J.*, 1931, 44, 191-193, 197).—An account of the advantages of sand tests and the methods of conducting the tests is given.
—J. H. W.

XVI.—FURNACES AND FUELS

(Continued from pp. 642-644.)

Automatic Control of Industrial Furnaces. Anon. (*Eng. Rev.*, 1931, 44, (12), 790).—The automatic furnace control described claims simplicity of operation, accuracy at 900° C. of $\pm 2^\circ$, considerable economy in fuel, and elimination of idle periods by automatic starting and stopping of the controller.
—P. M. C. R.

Gas Necessary in Conversion of Aluminium into Kitchenware. J. B. Nealey (*Amer. Gas Assoc. Monthly*, 1930, 12, 164-165; *Eng. Index*, 1930).—An outline is given of the process of rolling aluminium ingots and annealing the resultant sheets, as practised at the New Kensington, Pa., U.S.A. works of the Aluminum Company of America. Gas-fired furnaces are used. Temperature control is aided by recording pyrometers which record the heat in 6 sections of the furnace.—S. G.

Foundries Turn to Gas Fuel for Annealing. C. B. Phillips (*Amer. Gas Assoc. Monthly*, 1930, 12, 104-106, 138).—See this *J.*, 1930, 43, 699.—S. G.

Use of Gas- or Oil-Fired Furnaces for Die-Casting. K. Kaat-Jensen (*Tekniske Forenings Tidsskrift*, 1930, 54, (3), 29-43; *Eng. Index*, 1930).—The relative merits of gas and oil as fuel for small melting furnaces are discussed. Certain furnaces and die-casting machines manufactured in England are described.—S. G.

Special [Gas-Fired] Furnace Bright-Anneals Copper Wire in Steam Atmosphere. J. B. Nealey (*Iron Age*, 1932, 130, 143).—See *J.*, this volume, p. 582.
—J. H. W.

A Small Stationary Furnace for Aluminium Melting. Robert J. Anderson (*Indust. Gas (U.S.A.)*, 1931, March; and *Brass World*, 1931, 27, 104-105).—Describes a stationary-hearth furnace of small capacity (2,000 lb.), fired by natural gas. Drawings show the construction of the furnace, and a description of the material, its size, and the quantity required and the method of building and drying-out the furnace are given. The chief advantages of this type of furnace are low first cost of installation per unit of capacity, rapid melting, and good fuel efficiency. It can be readily adapted to a wide variety of melting conditions, can be constructed in any reasonable size over a wide range, and may be designed for firing with practically any fuel.—J. H. W.

Electric Melting and Heating of Metals. W. S. Gifford (*Met. Ind. (Lond.)*, 1930, 37, 481-484).—Read before the Manchester Association of Engineers, being a description of arc, induction, high-frequency induction and resistance electric furnaces, and their application individually to the melting and heat-treatment of metals, with notes on linings and the design and efficiency of electric furnaces.—J. H. W.

Contribution to Our Knowledge of the Crucible Induction Furnace and Its Metallurgy. M. H. Kraemer (*Z.V.d.I.*, 1932, 76, 866).—An induction furnace for crucible melting is described; it operates up to 130 kva. and is connected to a primary fed with alternating current at 6000 v. and 50 cycles, which is transformed by means of a transformer, a battery of variable condensers and a rotating spark gap into high-frequency current of 8,000-12,000 v. and 5,000-700,000 cycles. The furnace winding consists of flat-drawn water-cooled copper tube. The crucibles are made of clay-graphite mixtures or stamped up "Eisenberger Klebsand"; fritted mixtures of fused magnesia

with oxide additions made by the Northrup process may also be used. Temperatures of up to 3400° C. can be obtained.—v. G.

The Applications of the Rocking Indirect Arc Electric Furnace. A. E. Rhoads and Carl H. Morken (*Trans. Electrochem. Soc.*, 1932, 61, 161-190).—See *J.*, this volume, p. 583, and following abstract.—S. G.

Discussion on A. E. Rhoads and Carl H. Morken's Paper on "The Applications of the Rocking Indirect Arc Electric Furnace." A. D. Meyer. J. S. Vanick. F. W. Brooke. B. Stoughton. C. H. Morken (*Trans. Electrochem. Soc.*, 1932, 61, 190-192).—Cf. preceding abstract. Vanick discusses the manufacture of "Ni-resist" a corrosion- and heat-resisting iron alloy containing nickel 14, copper 2, and chromium 2%. In this furnace the carbon monoxide and carbon dioxide do not exert an appreciable oxidizing influence.
—W. A. C. N.

New Electric Furnaces. E. Fr. Russ (*Trans. Electrochem. Soc.*, 1932, 61, 207-214).—See *J.*, this volume, p. 198, and following abstract.—S. G.

Discussion on E. Fr. Russ' Paper on "New Electric Furnaces." H. Giesecke. E. Fr. Russ (*Trans. Electrochem. Soc.*, 1932, 61, 214-215).—Cf. preceding abstract. G. asserts that the selection of the proper size of furnace for a particular purpose is purely one of economics and quotes examples. The size of the furnace has no direct influence on labour costs.—W. A. C. N.

Melting Fine Silver in High-Frequency Induction Furnace. Daniel L. Ogden (*Trans. Electrochem. Soc.*, 1932, 61, 203-205).—See *J.*, this volume, p. 583.—S. G.

Electrically Heated Annealing Furnaces for the Steel and Other Industries. J. C. Woodson (*Iron Steel Eng.*, 1931, 8, 122-128; and (abstract) *Heat Treating and Forging: Furnaces*, 1931, 17, 285-288, 291).—Abstract of paper read before the American Institute of Electrical Engineers. A review of recent progress in annealing both ferrous and non-ferrous metals in electrically heated furnaces.—J. H. W.

Temperature Control for Hardening Furnace. Anon. (*Machinery (N.Y.)*, 1930, 36, 768-769).—The temperature of the electrically heated lead bath described is controlled by an immersed thermocouple, and a system of coloured lights is employed to indicate excessive fall of temperature due, for example, to the too rapid introduction of the pieces to be heat-treated.—H. F. G.

The Electric Furnace in the Patent Office. Joseph Rossman (*Trans. Electrochem. Soc.*, 1932, 61, 247-254).—See *J.*, this volume, p. 198.—S. G.

Regulation of Electric Furnaces by Tension Variation. Paul Bergeon (*Bull. Soc. Franç. Elect.*, 1930, [iv], 10, 1057-1060).—This method eliminates constant displacement of electrodes, and by reducing wear ensures a more regular run; less power is required in handling, the power absorbed by the furnace can be instantly and profoundly modified, and the system can be kept closed, with consequent easy disposal of gases. These advantages would appear to compensate for the somewhat complex and delicate installation involved.—P. R.

[Chromium-Nickel] Heating Element Deterioration Reduced in Cyanide Furnaces. R. F. James and Glenn Coley (*Elect. World*, 1931, 97, 1057-1058).—Cf. this *J.*, 1931, 47, 410.—S. G.

FUELS

Possibility of Manufacturing Metallurgical Coke from Rumanian Coal.—I. I. L. Blum (*Bul. chim. soc. române chim.*, 1930, 33, 45-50).—S. G.

Measurement of Heat Value of Solid Fuels. Jos. Kroenert (*Arch. tech. Messen*, 1931, (Sect. V 9214-1), 14T; *C. Abs.*, 1932, 26, 4932).—The heat value of solid fuels is calculated either indirectly from the chemical analysis or is determined directly in a calorimeter. The methods are described and the procedures outlined.—S. G.

XVII.—REFRACTORIES AND FURNACE MATERIALS

(Continued from pp. 644-647.)

Furnace Refractory Repairs. Anon. (*Eng. Rev.*, 1931, 45, (1), 52).—Pibrico, a semi-baked and pre-shrunk plastic refractory, is described. It is claimed that this material is suitable either for small repairs where brickwork or tiles cannot be fitted, or for large renewals.—P. M. C. R.

Brief Characteristics of American Refractory Materials. W. N. Shvctzov (*Uralskiy Tehnik (Ural Technologist)*, 1931, 7, (11-12), 60-61).—[In Russian.] The chemical composition, structure, and mechanical properties of a number of samples of American refractory materials are given, without any indication of their origin.—N. A.

On the Standard for Chamotte Bricks (OST 75). J. Ostashevsky (*Vestnik Standartizatsii (Messenger of Standardization)*, 1931, (2-26), 46-49).—[In Russian.] A critical examination of the Standard for chamotte bricks (OST 75).—N. A.

High-Duty Heat-Insulators. Anon. (*Maschinenkonstrukteur*, 1931, 64, 24-25).—The properties of Sterchamol bricks are compared with those of cristobalite and other heat-insulators. Sterchamol, a proprietary mixture prepared from a Danish kieselguhr containing a certain proportion of clay, is claimed to combine lightness and a sufficient degree of compressive strength with a low coeff. of thermal expansion and great stability on direct exposure to flame, and thus to be superior to cristobalite, which has a coeff. of expansion seven times that of Sterchamol, and which further requires protection against direct exposure.—P. M. C. R.

High-Temperature Heat Insulation. J. B. Barnitt and R. H. Heilman (*Mech. World*, 1931, 90, 332-333, 355-356; and *Chem. and Met. Eng.*, 1931, 38, 390-393).—Abstracts *in extenso* of paper read before the Engineers' Society of Western Pennsylvania. See *J.*, this volume, p. 586.—F. J.

XVIII.—MISCELLANEOUS

(Continued from pp. 647-649.)

The World of Metallurgy. John A. Mathews (*Amer. Inst. Min. Met. Eng. Preprint*, 1931, Sept., 1-13).—A general discussion embracing a glimpse of the history of metallurgy, modern applications of iron alloys, the importance of research, the research mind, and metallurgical education.—W. A. C. N.

On the Development of the Science of Metals. G. Tammann (*Naturwiss.*, 1932, 20, 1-6).—A review of recent work on the crystalline state and the affinities of the chemical elements.—J. W.

Recent Tendencies in Methods of Study of Metals and Alloys (1928-1930). Léon Dlougatch (*Rev. Mét.*, 1932, 29, 215-220, 276).—(I.—) A general discussion of the lines along which leading metallurgical researches of different countries have been conducted in recent years. The introduction into the tests of metals, of conditions representing those to be withstood in service; researches directed towards the establishment of standard methods of investigation of metals and alloys on a sound theoretical basis; and researches introducing new methods of investigation are discussed. (II.—) The use of several different methods of investigation simultaneously in connection with a particular piece of research is discussed and reference is made to typical examples of published work. Reference is also made to short-time tests to obtain approximate results instead of more accurate tests requiring long periods.—H. S.

The International Association for Testing Materials. W. Rosenhain (*Brit. N.-F. Metals Res. Assoc., Reprint Circ. and Series No. 98*, 1932, 1-8).—A general description of the old International Association for Testing Materials which

existed before the war, and of its revival after a Congress at Amsterdam in 1927. As now constituted the Association does not deal with the question of international standard specifications. The next Congress is to be held in London in 1935 under the presidency of Dr. Rosenhain.—W. H. R.

The Work of the "Metals" Section, Zürich Congress, International Association for Testing Materials. A. Portevin (*Rev. Mét.*, 1932, 29, 44-51).—Summaries of papers presented at the Congress; all have been already abstracted in *Metallurgical Abstracts* from the advance copies.—H. S.

Engineering Research. Thomas Ernest Stanton (*Proc. Inst. Civil Eng.*, 1930-31, 232, 386-418).—The James Forrest Lecture for 1931, deals with the progress and development of research in engineering, and contains references to researches on non-ferrous materials carried out in the Engineering Department of the National Physical Laboratory for various Research Boards and Associations.—J. W. D.

Problems of Standardization of Zvetmetzoloto and the Rôle of Research Institutes. N. Muratch (*Vestnik Standartizatii (Messenger of Standardization)*, 1931, (8-32), 18-20).—[In Russian.] Cf. *J.*, this volume, p. 203. Standardization must be linked with the industrial application of non-ferrous metals. Data on the schemes of scientific research work on standardization for 1931 and 1932 are given.—N. A.

Standardization in Non-Ferrous Metallurgy (Standardization Plan for 1932). N. Muratch and M. Rezkov (*Vestnik Standartizatii (Messenger of Standardization)*, 1932, (2-38), 13-16).—[In Russian.] The work on standardization in non-ferrous metallurgy in 1931, the basic features of the 1932 plan aiming at making the industry independent of imports, a classification of alloys, and the development of standard and rapid methods of analysis are described. The scope and nature of the scientific research work are also outlined.—N. A.

Capital Expenditure in the Non-Ferrous Metal Industry [of the U.S.S.R.] in 1931. A. I. But (*Zvetnye Metally (The Non-Ferrous Metals)*, 1931, (6), 777-782).—[In Russian.] A summarized review of the capital expenditure in the non-ferrous metal industry during 1931, both actual and estimated. The capital cost data are split up into items covering respectively industrial construction and plant (70.5% of total), prospecting and research work (13.5%), housing and social construction (13.7%), and miscellaneous expenditure (2.3%). The total contemplated expenditure is 375,500,000 roubles, of which 106,100,000 roubles are for copper and nickel; 58,300,000 for zinc and lead; 58,700,000 for aluminium and magnesium; 12,500,000 for the rare elements; 29,100,000 for the metal-working plants; 10,100,000 for central administration, and 100,700,000 for the gold industry. A table of the estimated capacities and capital costs of the various plants is given, the distinguishing feature of which is the very high capital cost per ton-year (in gold pounds), copper being £200-£275; nickel £465; zinc £80-£150; lead £75; aluminium £600-£780. It is hoped to improve the housing of the workers, which is stated to be very bad (attaining only 20-40 ft.² per person), this being one of the main causes of the excessive fluidity of labour.—M. Z.

Thoughts and Wishes of the Editor for [the U.S.S.R. Non-Ferrous Metal Industry in] 1932. P. F. Simonov (*Zvetnye Metally (The Non-Ferrous Metals)*, 1931, (12), 1541-1545).—[In Russian.] A brief review of progress during 1931, and of the projected scheme for 1932. Satisfaction is expressed that a central co-ordinating administrative organ, Glavzvetmetzoloto, has been created. It is emphasized that current problems of production are not the main objective of the efforts of the non-ferrous metal industry in 1932, but the elaboration and developments of the schemes for regional combines of enormous size, such as the Balkhash and Kounrad copper plants (150,000 tons/year initial capacity, with expansion to 300,000 tons/year), the Kazpolic-metal (zinc, lead), Almalyk, &c.—M. Z.

Surface Ennobling of Metals by Diffusion. — Grube (*Z. ges. Giesserei-Praxis: Das Metall*, 1931, 52, 21-22).—Abstract of paper read before the Deutsche Gesellschaft für Metallkunde. Under the trade name of "Alpaka" a number of nickel-brasses of widely different composition are marketed. The specifications of the mechanical properties for rolling, stamping, drawing, pressing, and extruding the alloys and the requirements for a casting alloy are given. The heat-treatment required is briefly outlined.—J. H. W.

Salvaging Scrap in a Railroad Shop. A. Eyles (*Machinery (N.Y.)*, 1930, 36, 512).—Brief note of the methods used to recover various non-ferrous metals and alloys.—H. F. G.

What Goes Out in Your Waste Cans. Charles O. Herb (*Machinery (N.Y.)*, 1930, 36, 841-847).—Systematic methods of obviating waste and reclaiming scrap, as employed at the works of the A.C. Spark Plug Co., are described. Oil (600 gall. per day) is recovered from turnings, borings, &c., by centrifuging; buffing wheels previously discarded when worn down to 8-10 in. diam. are now run at higher spindle speeds until worn to 6 in. diam. Lead hammers and emery wheel centres are recast. All dross from soldering operations and from zinc and aluminium die-casting machines is sold to refiners.—H. F. G.

Problems of Aerostatics. Karl Thalau (*Z. Flug. u. Motor.*, 1931, 22, 229-241).—A discussion of aerostatic problems arising in certain classified types of structure from loading, construction, choice of materials, form of members, influence of constructional processes. Alterations in dimensions with varying temperature receive special consideration, and comparative figures are given on structures of Duralumin alone, wood and steel, and Duralumin and steel. Cases of fatigue failure near joints and welds are traced to the omission of heat-treatment to relieve stresses set up during manufacture. Stresses are thus classified: principal static stresses; stresses due to distortion sustained in manufacture; secondary stresses due to sharp angles, abrupt changes of cross-section, joints, &c.; dynamic stresses due to vibration, acceleration, or slowing. Lines of future investigation are indicated and a bibliography is appended.—P. M. C. R.

The Future of the Copper Industry. Arthur Notman (*Trans. Canad. Inst. Min. Met.*, 1931, 34, 57-64; discussion, 64-65).—See this *J.*, 1931, 47, 627.

—E. S. H.

The Heddernheim Copper Works, Frankfort. H. von Forster (*Cuivre et Laiton*, 1930, 3, 62-64, 95-97, 221-222, 241-243).—Reproduced from *Metallgesellschaft Periodic Rev.*, 1929, (2), 21-28. See this *J.*, 1930, 43, 786.

—W. A. C. N.

Copper in the Middle Ages. A. Chaplet (*Cuivre et Laiton*, 1929, 2, (23), 5-7).—Elementary founding and mechanical working of copper and cupriferos materials are described. Illustrations of 16th- and 18th-century methods are included.—W. A. C. N.

The Bessemerization of Bell Bronze. John B. Kasey (*Met. Ind. (N.Y.)*, 1932, 30, 185-186).—The same article is published in *Metal Ind. (Lond.)*, 1932, 40, 613-614. Cf. *J.*, this volume, p. 519.—A. R. P.

The Mass Production of Tin Containers. A. E. Hamblin (*Proc. Inst. Mech. Eng.*, 1931, 121, 589-598).—A general description of the methods for the production of tins with soldered or seamed joints. The testing of the original tin plate for quality by the "gelatine" (ferricyanide) method, and for pliability is briefly described, as well as the composition and testing of the solder. Some of the automatic machines are illustrated, but details are not given.

—W. H. R.

Some Comments on the Use of "Getters." George D. O'Neill (*Electronics*, 1931, 2, 510-511).—To help in the production of the high degree of vacuum, various substances which are known as "getters" are used in the manufacture of electric lamps and wireless valves. In lamp manufacture red phosphorus

is commonly used, whereas the silvery, mirror-like deposit on the inside of valves is due to the use of metallic magnesium as a getter. Barium is also extensively used, often in the form of the azide which is decomposed inside the valve; of late metallic barium protected by a copper sheath has become available. Other "getters" which have been tried are magnesium-barium and aluminium-barium alloys as well as calcium, lithium, and cerium.

—S. V. W.

XIX.—BIBLIOGRAPHY

(Continued from pp. 711-719.)

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

- Allcock, H. J., and Jones, J. R.** *The Nomogram. The Theory and Practical Construction of Computation Charts.* 8vo. Pp. viii + 209, illustrated. 1932. London: Sir Isaac Pitman and Sons, Ltd. (10s. 6d.)
- ***Aluminium Research Institute.** *Standard Methods for the Sampling and Analyzing of Aluminium and Certain Aluminium Alloys.* 4to. Pp. 24. 1932. Chicago, Ill.: The Institute, 308 West Washington St.
- ***American Society of Mechanical Engineers.** *Mechanical Catalog, 1932-33.* Uniformly presented and illustrated catalog information conveniently classified, describing the products of manufacturers of mechanical equipment. Twenty-second annual volume. 4to. Pp. 452. 1932. New York: The Society, 29 W. 39th St.
- Andruschen, A., and Diesperow, S.** *Tungsten.* [In Russian.] Pp. 20. 1932. Moscow and Leningrad: Zvetmetisdad. (Rbl. 0.85.)
- Bleibtreu, H.** *Le charbon pulvérisé, le poussier de charbon et leurs applications.* Traduit de l'allemand d'après la deuxième édition complètement revue et mise à jour par G. Saur. 8vo. Pp. xii + 546. 1932. Paris: Dunod. (164 francs.)
- ***Boerner, Martin.** Herausgegeben von. *Draht-Welt-Buch.* Zweite, verbesserte und erweiterte Auflage. Med. 8vo. Pp. x + 692, with 422 illustrations in the text and numerous tables. 1929. Halle (Saale): Martin Boerner Verlagsbuchhandlung. (R.M. 25; subscribers to *Drahtwelt*, R.M. 20.)
- ***Brenner, Paul.** *Jahresbericht 1932 der Stoff-Abteilung der DVL.* (Sonderdruck aus dem Jahrbuch 1932 der Deutschen Versuchsanstalt für Luftfahrt, E.V., Berlin-Adlershof. Herausgegeben von ihrem leiter Wilh. Hoff.) 8½ × 11½ in. Pp. 22 + 71, illustrated. 1932. München und Berlin: R. Oldenbourg. (Geh., R.M. 5.50.)
- [Contains the following papers: Paul Brenner, "Baustoffen bei der Konstruktion von Flugzeugen"; Karl Schraivogel und Erich K. O. Schmidt, "Untersuchung von Duralplattblechen" (from *Z. Metallkunde*, 1932, 24, 57-62; see J., this volume, p. 424); Erich K. O. Schmidt, "Der Oberflächenschutz der Flugzeugbespannstoffe" (from *Farben-Chemiker*, 1932, 3, 165-171, 209-214); Karl Schraivogel, "Prüfung von Flugzeug-Bespannstoffen"; Paul Brenner und Otto Kraemer, "Holzvergütung durch Tränken und Aufteilen in dünne Einzellen"; Martin Abraham, "Prüfung von Sicherheitsglas"; Kurt Matthaes, "Röntgenuntersuchung von Flugzeugbauteilen bei der DVL"; Paul Brenner, "Untersuchungen über Spannungs-Korrosionsrisse an Leichtmetallen" (from *Z. Metallkunde*, 1932, 24, 145-151; see J., this volume, p. 728).]
- ***British Aluminium Company, Limited.** *Aluminium Busbars and Connections.* (No. 351.) 7 in. × 9 in. Pp. 24, with 25 illustrations. [1932.] London: The British Aluminium Co., Ltd., Adelaide House, King William St., E.C.4.
- ***Burn, J. H.** *Aluminium and Food. A Critical Examination of the Evidence Available as to the Toxicity of Aluminium.* (British Non-Ferrous Metals Research Association, Research Reports, External Series No. 162.) Med. 8vo. Pp. 29. 1932. London: British Non-Ferrous Metals Research Association, Regnart Buildings, Euston St., N.W.1.

- Cissarz, A., and Jones, W. R. *German-English Geological Terminology: an Introduction to German and English Terms used in Geology, including Mineralogy, Petrology, Mineral Deposits, &c.* 8vo. Pp. xvii + 250. 1931. Leipzig: Max Weg; New York: D. Van Nostrand Co.; London: Thomas Murby and Co. (12s. 6d.)
- Fox, C. S. *Bauxite and Aluminous Laterite. A Treatise Discussing in Detail the Origin, Known Occurrences, and Commercial Uses of Bauxite.* Second edition, partly re-written and enlarged. 8vo. Pp. xxxi + 312. 1932. London: Crosby Lockwood and Son. (30s.)
- Gans, Richard, und Czerlinsky, Ernst. *Über das magnetische Verhalten ferromagnetischer Einkristalle.* (Schriften d. Königsberger Gelehrten Gesellschaft. Naturwiss. Klasse. Jahr 9, Heft 1.) Pp. 9. 1932. Halle: Niemeyer. (R.M. 2.80.)
- *Garre, Bernward. *Einführung in die Praktische Metallographie.* (Breitensteins Repertorien, Nr. 76.) Cr. 8vo. Pp. 52, with 53 illustrations in the text. 1932. Leipzig: J. A. Barth. (Br., R.M. 4.20.)
- *Grützner, A. *Eisen- und Stahlegierungen Patentsammlung.* Zugleich Anhang zur Metallurgie des Eisens in Gmelin's "Handbuch der anorganischen Chemie." Achte, völlig neu bearbeitete Auflage. Herausgegeben von der Deutschen Chemischen Gesellschaft. Roy. 8vo. Pp. vii + 308. 1932. Berlin: Verlag Chemie G.m.b.H. (R.M. 32.)
- Gwiazdowski, Alexander P., and Lord, C. B. *Economics of Tool Engineering. Jig and Fixture Design.* 8vo. Pp. ix + 203, illustrated. 1932. New York: McGraw-Hill Book Co., Inc. (\$2.50); London: McGraw-Hill Publishing Co., Ltd. (15s.)
- Hempel, E. *Über die Passivität des Chroms.* (Dresden, Techn. Hochschule, Dr.-Ing. Diss.) 8vo. Pp. 49, illustrated. 1932. Bückeburg: Herm. Prinz.
- Hönisch, W. *Die Anwendung umhüllter Elektroden in der Schweisstechnik.* (Berlin, Techn. Hochschule, Dr.-Ing. Diss.) 8vo. Pp. 46, illustrated. 1931. Leipzig: Frommhold und Wendler.
- *Imperial Institute. *The Mineral Industry of the British Empire and Foreign Countries. Statistical Summary (Production, Imports, and Exports) 1929-1931.* Med. 8vo. Pp. 398. 1932. London: H.M. Stationery Office, Adastral House, Kingsway, W.C.2. (6s. net.)
[Deals with: abrasives; aluminium; antimony; arsenic; asbestos; barium minerals; bismuth; borates; cadmium; china clay; chrome ore and chromium; coal, coke, and by-products; cobalt; copper; diamonds; diatomaceous earth; felspar; Fuller's earth; gold; graphite; gypsum; iron and steel; lead; magnesite; manganese; mica; molybdenum; monazite; nickel; nitrogen compounds; petroleum and allied products; phosphates; platinum; potash minerals; pyrites; quicksilver; salt; silver; strontium minerals; sulphur; talc; tin; titanium minerals; tungsten; uranium minerals; vanadium; zinc. The book concludes with a list of statistical publications issued throughout the world.]
- *Jakeman, C., and Barr, Guy. *Tests on Tin-Base and Lead-Base Bearing Metals.* Research No. 43: Bearing Metals and Lubricants. (British Non-Ferrous Metals Research Association, Research Reports, Association Series No. 289A.) Med. 8vo. Pp. 23, with 6 illustrations in the text. 1931. London: British Non-Ferrous Metals Research Association, Reguart Buildings, Euston St., N.W.1.
- Karpow, A. F. *Metallurgy.* [In Russian.] Pp. 109. 1932. Moscow and Leningrad: Verlag für Unterricht und Pädagogik. (Rbl. 2.)
- Kurzen, F. *Gleichgewichtsuntersuchungen mit Metallkarbide.* (Münster i. W. Universität, Philos. Diss.) 8vo. Pp. 36, illustrated. 1932. Emsdetten (Westf.): Heinr. u. J. Lechte.

- Libman, E. P. *Aluminium and Bauxite*. [In Russian.] Pp. 39. 1932. Moscow and Leningrad. Wiss.-Techn. Geolog. Verlag. (Rbl. 1.)
- *Lundquist, Eugene E. *Strength Tests on Thin-Walled Duralumin Cylinders in Torsion*. (National Advisory Committee for Aeronautics, Technical Notes No. 427.) 4to. Pp. 8 + 12 pp. of figures. 1932. Washington, D.C.: National Advisory Committee for Aeronautics.
- *Mellor, J. W. *A Comprehensive Treatise on Inorganic and Theoretical Chemistry. Volume XII. [U, Mn, Ma, Re, Fe (Part I).]* Med. 8vo. Pp. xiii + 944, with 178 illustrations in the text. 1932. London: Longmans Green and Co., Ltd. (63s. net.)
- Müller, W. *Zur Passivität des Chroms*. (Dresden, Techn. Hochschule, Dr.-Ing. Diss.) 8vo. Pp. 55, illustrated. 1932. Bückeburg: Herm. Prinz.
- *North, Sydney H. *Pulverized Fuel Firing*. Cr. 8vo. Pp. ix + 193, with 62 illustrations. 1932. London: Sir Isaac Pitman and Sons, Ltd. (7s. 6d.)
- Paschki, Victor. *Elektrische Industrieöfen für Weiterverarbeitung*. Pp. 305. Berlin: Julius Springer. (R.M. 31.50.)
- *Planck, Max. *The Mechanics of Deformable Bodies*. Being Volume II of "Introduction to Theoretical Physics." Translated by Henry L. Brose. Med. 8vo. Pp. 234, with 12 illustrations. 1932. London: Macmillan and Co. (10s. 6d. net.)
- *Rensselaer Polytechnic Institute. *Description of the Laboratories of Departments of Civil, Mechanical, Electrical, and Chemical Engineering, of the Physical, Chemical, Biological, and Mineralogical Laboratories, and of the Shop*. Med. 8vo. (Rensselaer Polytechnic Institute Bulletin, Volume 31, No. 3.) Pp. 80, illustrated. 1932. Troy, N.Y.: The Institute.
- *Ros, M. *Ergebnisse der an der Eidg. Materialprüfungsanstalt in den Jahren 1930-31 durchgeführten Versuche mit autogen und elektrisch geschweissten Stäben*. (Schweiz. Verband für die Materialprüfungen der Technik, Bericht Nr. 19.) 8½ in. × 11½ in. Pp. 39, with 67 illustrations. 1932. Zürich: Schweiz. Verband für die Materialprüfungen der Technik.
- Schuler. *Taschenbuch für wirtschaftliche Blechbearbeitung*. 8vo. Pp. 303. 1932. Göppingen: L. Schuler A.G.
- *Scientific and Learned Societies. *The Official Year-Book of Scientific and Learned Societies of Great Britain and Ireland; with a Record of Publications issued during the Session 1931-1932*. Compiled from official sources. Forty-ninth annual issue. Med. 8vo. Pp. vii + 167. 1932. London: Charles Griffin and Co., Ltd. (10s.)
- *Smith, (Sir) Frank E. *Industrial Research and the Nation's Balance Sheet*. Being the Eighth Annual Norman Lockyer Lecture, delivered on November 22, 1932, in the Hall of the Goldsmiths' Company, London. Med. 8vo. Pp. 27. 1932. London: British Science Guild, 6 John St., Adelphi, W.C.2. (1s.)
- Soulier, Alfred. *Traité de galvanoplastie. Sources de courant. Préparation des pièces. Cuirage. Nickelage. Argenture. Dorure. Reproduction des objets. Moulages. Recettes pratiques*. 8e. édition, revue et augmentée d'une annexe sur le chromage. Pp. 203. 1932. Paris: Garnier frères.
- *Spiers, H. M. Edited by. *Technical Data on Fuel*. Third edition, revised and considerably enlarged. 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.)

- Sseliwanow, B. P. *Laboratory Investigation of Moulding Sands*. [In Russian.] Pp. 151. 1932. Leningrad: Kubutschverlag. (Rbl. 2.)
- Steinberg, S. S. *Ferro-Alloys*. [In Russian.] Pp. 70. 1932. Swerdlowsk-Moskau: Ural'scher Bezirk des Verlages "Poligrafkniga." (Rbl. 0.75.)
- *Tani, Yasumasa. *On the Distribution of Crystal Lattice in a Stretched Aluminium Metal*. [In English.] (Journal of the Faculty of Engineering, Tokyo Imperial University, 1932, Vol. XX, No. 6.) 4to. Pp. 133-146, with 13 illustrations in the text, and 8 folding tables. 1932. Tokyo: Maruzen Co., Ltd., Tōri Nichōme, Nihonbashiku.
- Timoshenko, S. *Schwingungsprobleme der Technik*. Ins Deutsche übertragen von I. Malkin und E. Helly. 8vo. Pp. viii + 876, illustrated. 1932. Berlin: Julius Springer. (R.M. 26.)
- Ulrich, Carolyn F. Edited by. *Periodicals Directory. A Classified Guide to a Selected List of Current Periodicals, Foreign and Domestic*. 4to. Pp. xx + 323. 1932. New York: R. R. Bowker Co. (\$10.00.)
[Includes 6000 titles. The arrangement is alphabetical by subject, with a complete title index. There is also a useful classified list of published bibliographies of periodicals. The various engineering, technical, and industrial publications are well represented.]
- *Woxén, Ragnar. *A Theory and an Equation for the Life of Lathe Tools*. [In English.] (Ingeniörs Vetenskapsakademien Handlingar, Nr. 119.) Roy. 8vo. Pp. 73, with 46 illustrations in the text. 1932. Stockholm: Svenska Bokhandelscentralen A.-B. (Kr. 5.75.)

XX. BOOK REVIEWS

(Continued from pp. 719-720.)

- Draht-Welt-Buch.** Herausgegeben von Martin Boerner. Unter Mitwirkung der — Hubert, — Ackermann, — Kindermann, — Krause, und — Pomp. Zweite, verbesserte und erweiterte Auflage. Med. 8vo. Pp. x + 692, with 422 illustrations in the text and numerous tables. 1929. Halle (Saale): Martin Boerner Verlagsbuchhandlung. (R.M. 25; subscribers to *Drahtwelt*, R.M. 20.)

This book is a compendium of information on the wire industry and all those secondary industries which are necessary to its proper development. It has been compiled by the editor of the journal *Drahtwelt* in collaboration with a number of well-informed engineers and metallurgists, and its main object is to collect together the scattered data to which reference may from time to time be necessary. Without doubt the volume is a very valuable and useful production. To anyone connected with the manufacture of wire, from the original billet to the finished coils, the book is almost sure to be capable of supplying some useful information on some or all parts of the work. It is impossible to summarize, in a short review, the various branches of the industry to which reference is made; it must suffice to indicate very briefly the main trend of the different sections. More than 200 pages are devoted to descriptions of the preparation of iron wire—historical, types and methods of rolling, annealing, pickling and washing, recovery of iron sulphate, drying of the wire, coppered wire, lubricants, dies, diamond dies, polishing, lay-out of plant, electric annealing ovens, galvanizing, recovery of zinc ashes and hard zinc, electrolytic galvanizing, tinning, covering with lead. Throughout this section, and, indeed, throughout the book, there is a wealth of tables and diagrams illustrating accepted practice, properties of the products, design of rolling and drawing plants, &c., which are of direct interest to the manufacturer. The production of nails and hooks of various kinds is dealt with in the next division, and is followed by a description of the making of screws, barbed wire, and wire springs, wire netting showing different types of weaving and their modes of preparation, swivel hoops, links, and chains. The theoretical foundations of the manufacturing processes, the physical properties of wire in all conditions, and their variation with the changes in the normal procedure are discussed and illustrated by means of tables and curves, photomicrographs, and radiograms. Steel wire and steel ropes are the subject of the next section and this concludes the main ferrous section. On the non-ferrous side there are included the production of copper wire, and the influence of impurities on its properties; the tinning of copper wire; manufacture of brass wire; melting of brass alloys in various types of furnaces; aluminium wire and its properties relative to those of wires of other metals. The final section is given over to miscellaneous details such as enamelling, coating with nickel, chromium, cadmium, or brass, sherardizing, and colouring. A set of standard tables and a bibliography complete the volume.—W. A. C. NEWMAN.