

# METALLURGICAL ABSTRACTS

(GENERAL AND NON-FERROUS)

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Part 7

## I.—PROPERTIES OF METALS

(Continued from pp. 273-279.)

**\*Young's Modulus of Aluminium Rod Composed of Large Crystal Grains.** Miyabi Sugihara (*Mem. Coll. Sci. Kyoto Imp. Univ.*, 1934, [A], 17, 392-396).—[In English.] Metals composed of large grains are generally very soft. S. measured the Young's modulus of aluminium rods, composed of crystal grains of various sizes, by elongation tests and by the acoustical vibration method. The value of Young's modulus remained nearly the same irrespective of the sizes of the crystal grains, but the limit of elasticity decreased considerably with the growth of the crystal grains.—S. G.

**High-Grade Aluminium.** ——— (*Metallurgist* (Suppt. to *Engineer*), 1935, 10, 26-28).—A critical review of a paper by Jean Calvet, *Compt. rend.*, 1935, 200, 66-68; see *Met. Abs.*, this volume, p. 137.—R. G.

**\*Thermal Expansion of Monocrystalline and Polycrystalline Antimony.** Peter Hidnert (*J. Res. Nat. Bur. Stand.*, 1935, 14, 523-544; *Research Paper No. 784*).—Measurements of thermal expansion were carried out on 11 samples of single crystals of antimony and 3 samples of polycrystalline antimony at various temperatures between 20° and 560° C., and the data were correlated with the results obtained by previous investigators to 300° C. The linear expansion depends on the direction along which the measurements are made. For example, the linear expansion along the trigonal axis (0° orientation) of a single crystal is about twice as large as the expansion along a direction perpendicular to this axis (90° orientation). Equations were derived which show the relationships between the coeffs. of expansion and the orientations of single crystals. The linear thermal expansion curves of polycrystalline antimony show that there is no *polymorphic transition* between 20° and 560° C. The differences in the linear expansion of different samples of polycrystalline antimony are attributed to variations in the average orientation of the crystals. An illustration compares the linear thermal expansion of monocrystalline and polycrystalline antimony.—S. G.

**\*Metallic Gadolinium.** F. Troube (*Bull. Soc. chim. France*, 1935, [v], 2, 740-742).—Pure gadolinium can be prepared by electrolysis at 625°-675° C. of a fused mixture of gadolinium chloride 44, potassium chloride 44, and lithium chloride 12%, using 7-8 amp. at 10 v. with a molten cadmium cathode; the resulting cadmium-gadolinium alloy is distilled *in vacuo* at 450° C. until all the cadmium is removed, and the residual gadolinium is then treated at 1230°-1250° C. in a high vacuum to produce a sintered mass which does not oxidize on exposure to air and is not attacked by boiling water.—A. R. P.

**\*Making and Testing Single Crystals of Lead.** B. B. Betty (*Amer. Soc. Test. Mat. Preprint*, 1935, June, 1-8).—The creep characteristics were determined for specimens composed of only one crystal to eliminate the effect of movement at the grain boundaries, which, together with the deformation of the grains themselves, appear to determine the creep in polycrystalline lead. The method of casting the crystals, including the temperature and temperature gradient control necessary, is described. An inexpensive, rapid and sufficiently accurate method for determining the crystallographic orientation of the crystals is presented, which obviates the labour and time of the X-ray

\* Denotes a paper describing the results of original research.

† Denotes a first-class critical review.

method. Results of creep tests of 3 specimens are given. Planes of slip are identified with definite crystallographic planes known as octahedral planes.

—S. G.

**\*Estimation of the Thickness of the Contamination on the Surface of Metallic Lead.** Shin'ichi Shimadzu (*Mem. Coll. Sci. Kyoto Imp. Univ.*, 1934, [A], 17, 79-84).—[In English.] Powder photographs of surfaces of lead contaminated by oxidation showed that the contamination was composed mostly of the microcrystals of tetragonal lead oxide. By comparing the intensity of the diffraction lines due to the contamination and that of the lines of the lead underlying, the thickness of the contamination was estimated to be between 50 and 200  $\mu$ .—S. G.

**The Lead Cable Borer [Insect] in Japan.** Takejiro Nakata (*J. Inst. Teleph. Eng. Japan*, 1932, (109), 578-589).—[In Japanese.]—S. G.

**\*Total Radiation from Soot-Covered Nickel and from Sand-Blasted Molybdenum.** Tsuneo Harada (*Tokyo Elect. Rev.*, 1932, 7, 11-14; *Jap. J. Eng. Abs.*, 1935, 12, 46).—[In English.] The effects of sand-blasting and soot-covering in increasing the total radiation from nickel and molybdenum surfaces were investigated by measuring the total radiation from these surfaces. The total emissivity of soot-covered nickel is between 0.46 and 0.85, according to the thickness of the coating; that of sand-blasted molybdenum is between 1.99 and 2.36 times the value for polished surfaces. The range of temperature investigated was between 800° and 1100° K. for soot-covered nickel and between 1000° and 1800° K. for sand-blasted molybdenum. The effect of sand-blasting is greater at lower than at higher temperatures.—S. G.

**The Hardness of Single Crystals of Tin.** — (*Metallurgist* (Suppt. to *Engineer*), 1934, 9, 178-179).—A critical summary of a paper by E. Schmid, *Metallwirtschaft*, 1934, 13, 301; see *Met. Abs.*, 1934, 1, 552.—R. G.

**\*Effect of Bismuth as an Impurity on the Structure and Allotropic Transformation of Tin.** C. W. Mason and W. D. Forgeng (*Metals and Alloys*, 1935, 6, 87-90).—Cast "Chempur" tin, when etched with a 5% solution of nitric acid in absolute alcohol, shows a peculiar network structure which disappears on annealing at 200° C. for 50 hrs. and reappears after quenching or rapid cooling of the molten metal. Tin absolutely free from bismuth fails to show this phenomenon, whereas it reappears on addition of about 0.003% of bismuth. The structure is attributed to coring, since the solid solubility of bismuth in tin is about 1% at room temperature. Tin showing the cored structure undergoes the usual white  $\rightarrow$  grey modification on cooling, whereas when this structure is removed by annealing and the bismuth is all in solid solution, the transformation to grey tin does not occur. Bismuth-free tin may be made by electrolyzing a solution containing 250 grm. of stannous chloride crystals and 10 c.c. of nitric acid per litre; the colloidal metastannic acid formed absorbs the bismuth impurity.—A. R. P.

**\*The Effect of the Oxygen Content on the Electrical Characteristics of Valvular Films of Tungsten, Tantalum, and Niobium.** O. Mohr (*Z. Physik*, 1935, 93, 298-314).—The electrolytic valve action of tungsten, tantalum, and niobium is investigated.—J. S. G. T.

**On the Emission Characteristics of Tungsten Filaments.** Takuji Kuno (*Matsuda Kenkyū Jihō*, 1933, 8, (1), 41-54; *Jap. J. Eng. Abs.*, 1935, 13, 52).—[In Japanese.] The ripples of temperature and the emission due to the a.c. heating of filaments are described, as well as the phase difference between the filament voltage and the temperature ripple. K. also describes a method for obtaining the emission characteristics at wide ranges of the plate voltage and that of the plate current by the cathode-ray oscillograph. The Schottky effect is considered in particular, and the relation between the area of the active surface and the shape factor determined.—S. G.

†The "Single-Crystal" State of Metals. (Sir) H. C. H. Carpenter (*Trans. Inst. Min. Met.*, 1933-1934, 43, xli-lxii).—See *Met. Abs.*, 1934, 1, 555.

—I. M.

\*The Effect of Fluid-Pressure on the Permanent Deformation of Metals by Shear [Copper, Steel]. Gilbert Cook (*Inst. Civil Eng. Selected Eng. Papers*, 1934, (170), 1-17).—According to the maximum shear-stress and maximum shear-strain-energy hypotheses, applied fluid-pressure should be without effect on the resistance of metals to plastic flow; on the other hand, Mohr's theory relating shear-stress and normal pressure, and Haigh's total-strain-energy theory oppose this view. Measurements were made of the permanent set of mild steel and copper when subjected to pure shear in a medium of glycerine under 1 and 2500 atm. Known values of torque were applied to the specimens, which were in the form of helices, by means of axial loading. The steel helices were annealed at 900° C. and the copper at 500° C. for 20 minutes *in vacuo*. With mild steel, the permanent set below the yield-point was on the average increased 2.5 times by a fluid pressure of 2500 atm. This result indicates a lowering of the proportional limit by pressure, but is in only qualitative agreement with the total-strain-energy theory. The yield-point was not affected by pressure. With copper, the resistance to plastic flow was very slightly increased by pressure, and it appears reasonable to conclude that plastic flow is determined to a very close degree by the principal shear-stress.—J. C. C.

\*A Theory of the Plasticity of Crystals. G. I. Taylor (*Z. Krist.*, 1934, 89, 375-385).—Cf. *Met. Abs.*, 1934, 1, 379. [In English.] The experimental facts indicate that plastic distortion usually consists of the sliding of one plane of atoms over its immediate neighbour so that a perfect crystal is reformed after each jump. T. assumes that slipping occurs over limited lengths,  $L$ , of the slip-plane giving rise to "dislocations" at the ends of those lengths; this avoids the need for assuming large forces to account for the displacement of the whole slip-plane at once. It is assumed that at a sufficiently high temperature these dislocations can migrate through the crystal under the smallest shear-stress, and in this way a picture of the mechanics of plastic distortion is obtained. The theory gives a parabolic relation between stress and strain, and this is confirmed experimentally for metals which crystallize in the cubic system. The migration of the dislocation is assumed to be stopped by an internal fault surface, and in this way the theory is connected with those involving mosaic or lineage structures; the dimensions of the blocks indicated by this theory are of the order  $10^{-4}$  cm. in agreement with the evidence from other sources.—W. H.-R.

On the Effects of Thermal Stress and Strain on the Process or Mechanism of the Failure of Materials. Motoiti Kodama (*J. Soc. Mech. Eng. Tokyo*, 1933, 36, (192), 261-264).—[In Japanese.]—S. G.

On the Process and the Mechanism of Failure of Metals. Motoiti Kodama (*J. Soc. Mech. Eng. Tokyo*, 1933, 36, (193), 315-320).—[In Japanese.]—S. G.

On the Study of the Fatigue of Metals. Yukiti Asakawa (*J. Soc. Mech. Eng. Tokyo*, 1933, 36, (193), 321-322).—[In Japanese.]—S. G.

\*The Process of Creep of Metals. Atumaro Simidu (*J. Soc. Mech. Eng. Tokyo*, 1933, 36, (189), 7-11; *Jap. J. Eng. Abs.*, 1935, 13, 5).—[In Japanese.] By combining a mechanical lever or mechano-optical device with a rotating drum, more minute time-elongation curves for steel and aluminium were obtained with a magnification of deformation of 100 or 180 times. Summarizing the results, S. holds that creep is not a mere plastic flow of metal, as generally expressed, nor is it a mere repetition of sudden yielding, depending only on the temperature; it is an alternate repetition of two kinds of deformation.—S. G.



**\*Abnormal Creep of Metals and Alloys During Transformation.** Keiji Yamaguchi (*Bull. I.P.C.R., Tokyo*, 1933, 12, (7), 594-608; *Jap. J. Eng. Abs.*, 1935, 13, 14).—[In Japanese.] The rate of creep of metals and alloys during cooling and heating increases abruptly when their microstructure changes. The phenomenon was recognized for tin-bronze, brass, and aluminium-zinc alloy in the case of eutectoid transformation as well as in the secondary separation or dissolution of proeutectoid constituents. The same was also experienced in the graphitization of cast iron in the  $A_1$  transformation of eutectoid steel and in the  $A_3$  transformation of iron. Similar phenomena can be seen to a lesser degree in the transformation of  $\beta$ -brass near 470° C., whereas almost nothing could be seen in the  $A_2$  change of iron.—S. G.

**\*Relation Between Ordinary Strength and Creep Strength.** Atumaro Simidu (*J. Soc. Mech. Eng. Tokyo*, 1933, 36, (200), 831-834; *Jap. J. Eng. Abs.*, 1935, 13, 11).—[In Japanese.] Part of a general research on the creep of metals. S., who gives a theoretical explanation of creep strength at high temperatures, describes the existence and meaning of creep limit, and the relation as determined by experiment between ordinary strength and creep strength.—S. G.

**\*Measurement of Solid Viscosities of Metals [Aluminium, Duralumin, Copper, Brass] by Means of the Flexural Vibrations of a Bar.** Katutada Sezawa and Kei Kubo (*Rep. Aeronaut. Res. Inst., Tokyo Imp. Univ.*, 1933, 7, (89), 195-231; *Jap. J. Eng. Abs.*, 1935, 13, 15).—[In Japanese.] Describes the experimental determination of the coeff. of solid viscosity for aluminium, Duralumin, copper, and brass, by means of the flexural vibration of a bar, the resistance of a solid body due to damping being assumed to be proportional to the viscosity of the deformation of that body. It was found that the greater the amplitude, the greater becomes the coeff. of solid viscosity.—S. G.

**\*The Scattering of Light by Thin Metallic Films.** S. Rama Swamy (*Proc. Indian Acad. Sci.*, 1934, 1, 347-353).—The light scattered by sufficiently thin films of silver, aluminium, and tin is found to exhibit the anomalous depolarization characterizing metallic surfaces. This phenomenon is thus essentially a surface effect and not the ordinary Rayleigh type of colloidal scattering. Films thin enough to show the effect are found to exhibit no metallic reflection and to have a very large electrical resistance. It is suggested that metallic films have 3 possible different states, viz. a crystalline state with metallic properties, a two-dimensional gaseous state which is not metallic and is non-conducting, and an intermediate state with high electrical resistance. An evaporated silver film in the first state scatters little light; in the intermediate state it scatters bright orange yellow light, and in the two-dimensional gaseous state it scatters bright green light.—J. S. G. T.

## II.—PROPERTIES OF ALLOYS

(Continued from pp. 279-284.)

**\*Creep Characteristics of Aluminium Alloys.** R. R. Kennedy (*Amer. Soc. Test. Mat. Preprint*, 1935, June, 1-14).—Aluminium alloys are widely used in a variety of applications in which they are exposed to elevated temperatures. The short-time tensile properties at these temperatures have been studied by a number of investigators, but little attention has been paid to the long-time tensile properties or creep characteristics. Nine aluminium alloys that have been used or proposed for use at elevated temperatures were selected for investigation. The creep characteristics of these alloys were determined at 400° and 600° F. (205° and 315° C.). The creep rates of the alloys varied over a wide range. Sand-cast aluminium-copper-nickel-magnesium alloy had the best creep characteristics of the alloys tested. Some of the newer wrought and cast alloys were markedly inferior to this alloy in that respect, although their

mechanical properties at room temperature were superior in some cases and they have better casting and forging properties. A bibliography of 9 references is given.—S. G.

**\*Effect of Composition on Mechanical Properties and Corrosion-Resistance of Some Aluminium Alloy Die-Castings.** E. H. Dix, Jr., and J. J. Bowman (*Metals Technology*, 1935, 2, A.I.M.M.E. Tech. Publ. No. 616, 1-12).—See *Met. Abs.*, this volume, p. 212.—W. H. R.

**\*Hardening Effects of Heat-Treatment on Aldrey-Type Light Alloys.** Sakichi Kishino (*Nippon Kwagaku Kwai Shi (J. Chem. Soc. Japan)*, 1935, 56, 230-235; *C. Abs.*, 1935, 29, 3283).—[In Japanese.] When Aldrey in the completely annealed state is heated above 350° C., its hardness increases. This is owing to the solution of  $Mg_2Si$ . When quenched Aldrey is heated, its hardness increases suddenly at about 250° C. owing to the appearance of  $Mg_2Si$  crystals. From 250° to 450° C. the hardness decreases. Above 450° C. the hardness increases owing to the solution of  $Mg_2Si$ . The dilatation shows anomalies at 250° and 450° C.—S. G.

**\*On the Mechanism of the Ageing and Tempering of Quenched Aluminium Alloys.** Takeo Takeuchi (*J. Mining. Inst. Japan*, 1932, 48, (569), 873-898; *Jap. J. Eng. Abs.*, 1935, 12, 54).—[In Japanese.] Dilatation, electrical resistance, and hardness measurements were carried out on quenched aluminium alloys containing copper or magnesium and silicon. From these experiments, T. concludes that the solute atoms in the supersaturated solid solution are concentrated from place to place prior to their precipitation as  $CuAl_2$  or  $Mg_2Si$ . This affects the distortion of the mother lattice, and the alloy is hardened. The distortion will reach its limit, but slight heating causes softening by precipitation of the compound. These phenomena are repeated during the tempering and ageing of quenched aluminium alloys.—S. G.

**\*Mechanical and Ageing Properties of Duralumin.** Tsuneo Watase (*Suiyō-kwai-Shi*, 1932, 7, (38), 424-431; *Jap. J. Eng. Abs.*, 1935, 12, 55).—[In Japanese.] Annealed and cold-rolled, and aged and cold-rolled materials were all hardened with increase in the amount of cold-work. The material that had been cold-worked to the extent of only a few % immediately after quenching was very inferior in mechanical properties, while the effects of hardening were first observed after reduction of 10-12%. Age-hardening after cold-work was studied by measurements of hardness and electrical resistance. Hardening decreased with the amount of cold-work. Severe-cold-work, e.g. 50-65% reduction, caused no more hardening after working.—S. G.

**\*Investigation of the Al-Rich Al-Fe-Si System.** Hideo Nishimura (*Tetsu-to-Hagane*, 1932, 18, 849-860).—[In Japanese.] See abstract from English source, *Met. Abs.*, this volume, p. 147.—S. G.

**\*The Constitution of the Antimony-Tin-Zinc Alloys.** Robert Blondel and Paul Laffitte (*Compt. rend.*, 1935, 200, 1472-1474).—The alloys of the antimony-tin-zinc system have been studied by thermal analysis, taking recognized binary systems as bases. These latter were verified by thermal analysis and by metallography, which established a range of tin-rich solid solutions in the tin-zinc system, and confirmed the allotropic transformation at 325° C., and the compound  $Sb_2Sn_3$ , observed by Iwasé. The thermal analysis of the ternary system was carried out in vertical sections parallel to the binary system tin-zinc, and the results are incorporated in a plane equilibrium diagram. Three ternary peritectics were found,  $p_1$  (antimony 0.5, tin 91.5, zinc 8.0%),  $p_2$  (antimony 8, tin 91, zinc 1%) and  $p_3$  (antimony 53, tin 40, zinc 7%), giving rise to 3 transformations:  $p_1$ : liquid  $p_1 + ZnSb$  crystals  $\rightleftharpoons$  Zn crystals +  $c$  crystals at 197.5° C.;  $p_2$ : liquid  $p_2 + b$  crystals  $\rightleftharpoons$   $c$  crystals +  $ZnSb$  crystals at 235° C.;  $p_3$ : liquid  $p_3 + a$  crystals  $\rightleftharpoons$   $b$  crystals +  $c$  crystals at 395° C. The crystals  $a$ ,  $b$ , and  $c$  correspond, respectively, to the binary solution limit at 95% of antimony, the ternary solution limit at 42% of antimony (nearly  $Sb_2Sn_3$ ), and the summit  $\gamma'$  of the ternary solid solution  $c$

rich in tin. The melting point of the peritectic,  $p_1$ , was found by differential analysis to be  $197.5^\circ\text{C}$ ., higher than that of the nearly binary eutectic Sn-Zn ( $196^\circ\text{C}$ .). The existence of the tin-rich ternary solid solution,  $c$ , was confirmed by micro-examination and electrical-resistance measurements of specimens annealed at  $150^\circ\text{C}$ . for 11 days. The results seem to show that of all the compounds of zinc and antimony, only ZnSb plays any part in the ternary system, and is consequently the only one stable in the presence of tin.

—J. H. W.

**\*On Two Intermetallic Compounds of Beryllium with Iron.** L. Misch (*Naturwiss.*, 1935, 23, 287-288).—The beryllium-iron system contains a ferro-magnetic phase  $\text{FeBe}_2$ , the transformation point of which is  $521^\circ\text{--}524^\circ\text{C}$ ., and the direction of the strongest magnetism in which is in the hexagonal base. The phase has the  $\text{MgZn}_2$  structure with  $a = 4.212$  and  $c = 6.834\text{ \AA}$ .; the  $d$  is  $4.65$ . A second compound in this system is  $\text{FeBe}_5$ , which is non-magnetic at ordinary temperature but becomes so at the temperature of liquid air. It has a body-centred cubic structure with  $a = 5.878\text{ \AA}$ . and  $d = 3.17$ .

—B. Bl.

**Aluminium-Bronze: Its Properties and Applications.** — (*Metallurgia*, 1935, 12, 35-37).—A discussion on the composition, mechanical, and corrosion-resisting properties of cast and hot-worked "aluminium-bronzes" and some of their applications.—J. W. D.

**\*The Effect of a Third Element on the Ageing of a Binary System. I.—The System Copper-Aluminium-Nickel.** V. Gridnev and G. Kurdjumov (*Domez*, 1934, (11-12), 61-65; *C. Abs.*, 1935, 29, 3635).—[In Russian.] The addition of 2% nickel to the system copper-aluminium raises the eutectic from  $570^\circ$  to  $605^\circ\text{C}$ . and narrows the  $\alpha$ -field from 9.8 to 8.6% aluminium. Below the eutectic no change of solubility of nickel with temperature was observed.

—S. G.

**Cadmium-Copper for Overhead Lines.** G. W. Preston (*Elect. Rev.*, 1935, 116, 372-373).—A brief review of the mechanical and electrical properties of cadmium-copper as used for electrical conductors.—S. V. W.

**\*On Transitions in the CuAu Alloy.—II-III.** W. S. Gorsky (*Physikal. Z. Sowjetunion*, 1934, 6, 69-76, 77-81).—[In English.] (II.—) In continuation of previous work (*J. Inst. Metals*, 1928, 40, 575), an account is given of measurements of the velocity of transition of the crystal lattice of the alloy CuAu to the equilibrium state. The ratio  $a/c$  of the crystal lattice is expressed as a function of the annealing period. No mathematical formula capable of expressing the results was found. (III.—) The effect of strain, due to a change of the axial ratio  $a/c$ , on equilibrium in the ordered lattice of the alloy is investigated mathematically.—J. S. G. T.

**Wrought Copper-Nickel Alloys.** D. K. Crampton and H. P. Croft (*Metals and Alloys*, 1935, 6, 79-84).—Recent work on new nickel-copper alloys is reviewed, and the properties of the 92:4:4 and 91:7.5:1.5 copper-nickel-aluminium are discussed. The melting points are  $1090^\circ$  and  $1120^\circ\text{C}$ ., respectively, and the mechanical properties are:

	92:4:4 Alloy.		91:7.5:1.5 Alloy.	
	Annealed.	Reduced 80%.	Quenched.	Precipitation-Hardened.
Tensile strength, lb./in. <sup>2</sup>	45,000	120,000	48,000	110,000
Yield-point, lb./in. <sup>2</sup>	20,000	80,000	30,000	80,000
Elongation, %	60	12	50	10
Reduction in area, %	80	50	80	35
Modulus of elasticity, $\times 10^6$	21	18.5	21	18



Both alloys can be hot-worked, welded, and brazed, and both have a good resistance to corrosion.—A. R. P.

**\*Some Tests on Tin-Bronzes at Elevated Temperatures.** J. W. Bolton (*Amer. Soc. Test. Mat. Preprint*, 1935, June, 1-9).—The alloy specified in A.S.T.M. Standard Specifications for Steam or Valve Bronze Sand-Castings (B-61), an essentially solid-solution structure, is shown to have a "limiting creep strength" of about 8000 lb./in.<sup>2</sup> at 500° F. (260° C.) and to be free from embrittlement. At 600° F. (316° C.), the alloy has low "creep-strength" and is of low ductility after exposure to this temperature for long periods. The alloy specified in A.S.T.M. Standard Specifications for Sand-Castings of the Alloy: Copper 88, Tin 8, Zinc 4% (B-60) (the composition, copper 88, tin 10, zinc 2%, falling within this specification is the one specifically referred to), consists of an essentially solid solution matrix, throughout which a high tin component (the  $\alpha$ - $\delta$  eutectoid) is dispersed in small particles. This alloy's load-carrying characteristics at 500° F. (260° C.) are inferior to those of alloy B-61, and there is evidence of embrittlement on exposure to a temperature of 500° F. (260° C.). Microscopic study, especially of material exposed to a temperature of 600° F. (316° C.), shows clearly that this embrittlement is due to penetration or formation of the brittle eutectoid structure along grain boundaries.—S. G.

**\*Impact and Static Tensile Properties of Bolts [Steel, Monel Metal, Bronze, Brass].** Herbert L. Whittemore, George W. Nusbaum, and Edgar O. Seaquist (*J. Res. Nat. Bur. Stand.*, 1935, 14, 139-188; *Research Paper No. 763*).—This investigation was carried out to determine the properties of bolts under impact tensile loading and also under static tensile loading. 360 specimens were tested, representing all possible combinations of 5 different materials (chromium-nickel steel, cold-rolled steel, Monel metal, bronze, and brass), 4 different bolt diameters ( $\frac{3}{8}$ ,  $\frac{1}{2}$ ,  $\frac{5}{8}$ ,  $\frac{3}{4}$  in.), and 3 different forms of screw threads (American National coarse, American National fine, and Dardelet). These threads are often used by U.S. engineers for bolts. The U.S. Standard threads are almost the same as the American National coarse threads and the S.A.E. threads almost the same as the American National fine threads. The bolts of different diameters were geometrically similar, the length between the head and the bearing face of the nut being 5 times the diameter, the thread extending inward from the face of the nut 1 diameter. In all cases the impact work for bolts with American National coarse threads was less than for bolts of the same size and material with American National fine threads. Except for the brass bolts and those cold-rolled steel bolts which showed brittle failures, the impact work for bolts with American National fine threads was approximately the same as for bolts of the same size and material with Dardelet threads. In all cases the impact work for bolts with Dardelet threads was much greater than for bolts of the same size and material having American National coarse threads. Similar relations were observed for the static work and the maximum static load. For bolts of the same size and having the same threads the bolt efficiencies were approximately the same for all of the materials.—S. G.

**\*Influence of Iron, Aluminium, and Silicon on the Impact Values of Brasses at Higher Temperatures.** Masaichi Nishikawa and Eiichi Ito (*Suiyōkwaishi*, 1934, 8, 625-629; *C. Abs.*, 1935, 29, 3283).—[In Japanese.] Brasses were prepared containing 62-65% copper and small amounts of impurities of iron, aluminium, and silicon less than 1%, and their Charpy impact values at higher temperatures were measured. Iron did not have a great influence on the impact value of these brasses, and they showed maximum impact values at 750°-850° C. according to the copper content. Aluminium and silicon, however, had a much greater effect on the impact value, and the temperatures showing the maximum impact value were displaced to the lower temperatures 500°-700° C. and 450°-650° C., respectively, in the brasses containing aluminium and copper.—S. G.

**\*Gold-Cobalt Resistance Alloys.** James L. Thomas (*J. Res. Nat. Bur. Stand.*, 1935, 14, 589-593; *Research Paper No. 789*).—Gold-cobalt alloys containing 0.75 to 5% cobalt were prepared and investigated to determine if they are suitable for use in the construction of electrical resistance standards. The temperature coeff. of electrical resistance of the alloys containing 1.5 to 2.5% cobalt is small at room temperatures, but the thermoelectric power of the alloys against copper is large. These alloys were found to be inferior to gold-chromium alloys of about the same proportions.—S. G.

**\*A Study of Lead Cable Alloys.** Hisakichi Shimba (*Suiyōkai-Shi*, 1932, 7, (39), 432-443; *Jap. J. Eng. Abs.*, 1935, 12, 55).—[In Japanese.] Tensile and bending tests were carried out on age-hardened lead cable alloys containing antimony, tin, and calcium; the electrical and fatigue properties were also measured. Lead alloys containing 1% antimony should be quenched at temperatures above 225° C. for age-hardening. Air-cooling also causes hardening. The properties of lead alloys containing 0.96% calcium are greatly improved by quenching in oil at 100° C. from temperatures of more than 235° C. The effects of the addition of 0.2-1.5% tin to lead alloys containing 0.04-0.08% calcium were examined. The strength of alloys extruded at 255° C. is decreased by the addition of tin; ageing at 60° C., however, increases the strength to 600 kg./cm.<sup>2</sup>. An alloy containing 1% antimony has superior fatigue properties to one containing 3% tin, while a lead alloy containing 0.04% calcium has far better fatigue properties. Tensile strength and elastic limit are markedly reduced by long loading, the limit being 10% (15 kg./cm.<sup>2</sup>) of the tensile strength. The fatigue failure of lead occurs at the crystal boundaries. Work and age-hardening increase the endurance limit.—S. G.

**\*The Surface Tension of Molten Lead Alloys under Oxidizing Conditions.** H. Vance White (*Metals and Alloys*, 1935, 6, 53-56).—The surface tension of monotype metal containing lead 76.5, antimony 16.5, and tin 7% is reduced by 30% by addition of 0.05% of sodium and increased by 28% by addition of 0.2% of zinc. Potassium and cadmium increase the surface tension by about 4%. Addition of sodium to lead is just as satisfactory as addition of arsenic for making spherical shot, but it has practically no hardening effect.—A. R. P.

**\*Bearing Analysis Determines Permissible Speeds.** William A. Rowe (*Machine Design*, 1935, 7, (1), 30-32).—The value of the following bearing metals for use in centrifugal fans has been examined: (A) lead 75.7, tin 11.6, antimony 12.2, copper 0.5%; (B) lead 50, tin 38, antimony 11.5, copper 0.5%; (C) tin 89.5, antimony 7.5, copper 3%. In all cases the increase in temperature at journal velocities ( $V$ ) of 10-40 ft./second has been plotted against  $PV$ , where  $P$  is the unit pressure per in.<sup>2</sup> of projected area. With  $V$  not exceeding 20 ft./second  $A$  gives the best results, but  $B$  is satisfactory up to  $V = 30$  ft./second. At higher values of  $V$  the tin-base alloy  $C$  is much superior to the others. The best criterion for evaluating the performance of a bearing metal is considered to be the value of  $PV^2$  for a definite rise in temperature. For an increase of 70° F. (39° C.)  $PV^2 = 9000$  for  $A$ , 24,000 for  $B$ , and 18,000 for  $C$ . These figures show that alloy  $B$  may be used as a substitute for the expensive tin-base alloys when  $V$  does not exceed 30 ft./second.—A. R. P.

**\*The Constitution of the Lithium-Bismuth Alloys.** (Zintl and Brauer.) See p. 343.

**\*The Constitution of the Lithium-Cadmium Alloys.** (Zintl and Schneider.) See p. 343.

**\*On the Equilibrium Diagram of the Magnesium-Zinc-Tin System.** Buntarō Otani (*Tetsu-to-Hagane*, 1933, 19, (7), 566-572; *Jap. J. Eng. Abs.*, 1935, 13, 62).—[In Japanese.] The ternary diagram of the magnesium-zinc-tin system was investigated by thermal and microscopic analyses. It was found



to consist of 12 primary crystallization surfaces, 15 univariant lines, and invariant points. The invariant points are summarized as follows :

Composition.			Temperature, ° C.	Reaction.
Mg.	Zn.	Sn.		
2	6	92	175	Liq. = Zn + Sn + $\epsilon$
4	88	8	346	Liq. = Zn + $\epsilon$ + s
4.5	87.3	8.2	354	Liq. + $\gamma$ = s + $\epsilon$
45	53	2	351	Liq. + $\gamma$ = $\gamma'$ + $\epsilon$
46.3	53.2	0.5	340	Liq. = $\gamma'$ + $\epsilon$ + s
46.3	53.2	0.5	340	Liq. = $\eta$ + $\gamma'$ + s

—S. G.

**\*Working Properties of Magnesium Alloys.** Shirō Ishida (*Tetsu-to-Hagane*, 1932, 18, 705-742; *Jap. J. Eng. Abs.*, 1935, 12, 52).—[In Japanese.] The cold- and hot-working properties of alloys of magnesium with aluminium and zinc were studied. It is concluded that magnesium alloys should be hot-rolled at 300° C., the temperature of the rolls being maintained at 250°-300° C. Magnesium alloys containing up to 7% aluminium and magnesium-zinc alloys with up to 5% zinc can be hot-rolled; the maximum limit of cold-rolling being a reduction of 10%. The tensile strength of magnesium alloys is not increased by cold-work so much as hardness; elongation and reduction of area are decreased. The temperature of recrystallization was found, by the X-ray method, to be 170°-200° C.; annealing should be carried out at 300° C. Of the metals zinc, manganese, beryllium, cadmium, &c., zinc and manganese affect the working properties of magnesium-aluminium alloys more favourably than the others.—S. G.

**\*Electrosynthesis of Silver, Tin, and Zinc Amalgams, and Their Chemical Structure.** Kazimierz Duzko (*Wiadomości Farm.*, 1934, 61, 633-636, 667-671, 683-686, 698-700 (700 in German); *C. Abs.*, 1935, 29, 2859).—The amalgams are prepared by the modified electrosynthetic method of Kerp (*Z. Elektrochem.*, 1898, 3, 308) and by mixing electrolytically dispersed silver with mercury. The silver amalgams differ in hardness, electrical conductivity, and electrode potential, depending on the method of preparation, and must be regarded, therefore, as different substances. On the basis of their mercury % content, their volume changes, specific conductivity, electrode potential, and photomicrographs, these amalgams are classed as binary alloys showing a crystallographic structure and possessing AgHg as the simplest chemical compound. Tin amalgams are crystalline chemical compounds of the formula Sn<sub>2</sub>Hg with a volume increase of 8%; they can exist in an equilibrium with free mercury. Zinc amalgams represent a common physical mixture as has been reported by Puschin (*Z. anorg. Chem.*, 1903, 36).—S. G.

**\*Intermetallic Compounds Formed in Mercury. V.—Compounds in the Zn-Mn, Zn-Co, Zn-Ni, Al-Fe, Sn-Mn, and Sn-Co Systems.** Alexander S. Russell, T. R. Kennedy, and R. P. Lawrence (*J. Chem. Soc.*, 1934, 1750-1754).—A number of compounds, including some new ones, has been found by the mercury method. The empirical formulæ agree with those obtained by thermal and X-rays methods.—S. V. W.

**\*Aluminium-Copper-Nickel Alloys of High Tensile Strength Subject to Heat-Treatment.** W. A. Mudge and Paul D. Merica (*Metals Technology*, 1935, 2, A.I.M.M.E. Tech. Publ. No. 619, 1-12).—A brief description of the mechanical properties of "aluminium-Monel metal" made by adding 4% aluminium to ordinary Monel metal containing about 68% nickel; data

for other aluminium-copper-nickel alloys are also given. These alloys are soft and ductile when quenched from 1200° F. (649° C.) or above, the maximum softness occurring after quenching at or above 1500° F. (815° C.). On slow cooling from temperatures between 1200° and 2100° F. (649° and 1148° C.), they become hard, with high tensile strength and moderate ductility. Tensile strengths of the order 100,000 to 150,000 lb./in.<sup>2</sup> can be obtained, with elongation values between 15 and 30%. Both the soft and the hard forms of the alloy appear as homogeneous solid solutions when examined microscopically, and the nature of the transformation is unknown. The corrosion-resistance of the "aluminium-Monel metal" is similar to, or slightly better than that of ordinary Monel metal.—W. H.-R.

**\*Influence of Stress on the Magnetic Properties of Super-Permalloy.** Masaru Fukuda and Ryōtarō Nomiyama (*Bull. Tokyo Univ. Eng.*, 1933, 2, (7), 396-398; *Jap. J. Eng. Abs.*, 1935, 13, 43).—[In Japanese.] The influence of mechanical stresses on the permeability of iron alloys of high permeability was investigated as a matter of technical as well as scientific interest. The paper also deals with the magnetic skin effect of the alloys.—S. G.

**\*The Ferromagnetism of the Platinum-Chromium Alloys.** E. Friederich and A. Kussmann (*Physikal. Z.*, 1935, 36, 185-192).—The region of composition within which the platinum-chromium alloys are ferromagnetic extends from 7 to 20% chromium; the corresponding atomic-% of chromium are 22-48.5%. Magnetic saturation in the case of the alloy containing about 10% chromium (30 atomic-%) corresponds to a field-strength of about 3000 c.g.s. units. Micrographic and X-ray investigations show that crystalline superstructure, based on the presence of a compound, apparently PtCr<sub>3</sub>, is present in the ferromagnetic alloys and extends to high chromium content, and that the ferromagnetic range is entirely a transition region.—J. S. G. T.

**\*Reactions in Solid Metallic Systems [Silver-Aluminium Alloys].** André Hone (*Rev. trimest. canad.*, 1934, 20, 376-391; *C. Abs.*, 1935, 29, 3209).—The variation of electrical conductivity with time was measured for alloys of silver containing 38.00, 28.45, 19.85, 11.18, and 4.78% aluminium, at const. temperatures of 331°, 304°, 265°, and 220° C. A mathematical development, based on the kinetic theory of gases, is presented to explain the course of decomposition of the alloys. The "energies of activation" for the reaction  $\delta$ -phase  $\rightarrow$   $\gamma$ -phase are for the conditions of temperature used 22.0, 22.6, 25.6, 15.7, and 9.3 cal./gram. mol., respectively, for the alloys in the order given above.—S. G.

**Special Alloys.** — (*Giesserei-Praxis*, 1935, 56, 36, 37, 100, 122).—See also *Met. Abs.*, 1934, 1, 125, 172, 346, 495, 575, and this volume, p. 219. [Note: It seems that this list of alloys will continue to appear in alphabetical order; the continuations of the series will not be referred to in *Met. Abs.*] The composition and some properties and applications are given for: Forbe's metal, Frary metal, Fontane's metal, Frary light metal, Fricke's new silver (nickel-brass), Frischmut aluminium solder, Gedge's brass, Gemma bearing metal, genuine Babbitt, Germania white bronze, Genelit, Gliavor bearing metal, gold-copper, and Giuschi-Buischi.—J. H. W.

### III.—STRUCTURE

(Metallography; Macrography; Crystal Structure.)

(Continued from pp. 284-291.)

**†Preparation of Lead and Lead-Rich Alloys for Microscopic Examination.** W. H. Bassett, Jr., and C. J. Snyder (*Metals and Alloys*, 1935, 6, 125-129).—Recent methods for preparing sections of lead alloys for micrographic examination are reviewed, and the sphere of usefulness of 8 etching reagents is indicated. Characteristic photomicrographs of numerous alloys are shown.—A. R. P.

**Mounting Concentrates and Tailings for Microscopic Study.** Paul H. Bird (*Eng. and Min. J.*, 1935, 136, 233-234).—Whilst mainly directed towards the mounting of geological specimens, the methods suggested might be employed in metallurgical work. Synthetic resins, such as Bakelite, are used as the cementing media.—R. Gr.

**\*Melting of Metal Crystals at Their Boundaries, and a Theory of Recrystallization.** Usaburo Yoshida and Kazuo Koyanagi (*Mem. Coll. Sci. Kyoto Imp. Univ.*, 1935, [A], 18, 9-16).—[In English.] It is found that when the temperature of a metal is increased to a value just below its melting point, the metal melts at its crystal boundaries. On the assumption that the metal melts at its crystal boundaries at its recrystallization temperature, a theory of the recrystallization of metals is proposed.—S. G.

**The Structure of Metallic Coatings, Films, and Surfaces.** — (*Metallurgist* (Suppt. to *Engineer*), 1935, 10, 22-24).—A review of a General Discussion held by the Faraday Society; see *Met. Abs.*, this volume, pp. 284-289.

—R. G.

**\*Structure and Properties of Nickel Deposited at High Current Densities.** William Blum and Charles Kasper (*Monthly Rev. Amer. Electroplaters' Soc.*, 1935, 22, (5), 19-30).—See *Met. Abs.*, this volume, p. 287.—A. R. P.

**\*X-Ray Studies of the System Iron-Chromium-Nitrogen.** Sten Eriksson (*Jernkontorets Ann.*, 1934, 118, 530-543; *C. Abs.*, 1935, 29, 2829).—Iron-chromium nitrides were prepared by passing  $\text{NH}_3$  over the heated alloys. An intermediary phase ( $\alpha'$ ) of the formula  $\text{FeCr}$  was confirmed, and is probably to be considered a deformed  $\alpha$  lattice. The symmetry, however, is low and either tri- or mono-clinic. In the chromium-nitrogen system the hexagonal  $\beta$ -phase has a "super structure," with a volume 3 times that of the close-packed hexagonal lattice. The length of the  $c$  axis is the same for both cells but that of the  $a$  axis is 1.732 times that of the close-packed lattice. The homogeneity limits are 11.9-9.3% nitrogen. The dimensions range from  $a = 4.750$  A. (2.742 A.),  $c = 4.429$  A. (4.429 A.) and  $c/a = 0.933$  (1.615) at the lower limit to  $a = 4.796$  A. (2.769 A.),  $c = 4.470$  A. (4.470 A.) and  $c/a = 0.932$  (1.614) at the upper limit, the numbers in parentheses referring to the hexagonal close-packed cell.—S. G.

**The Alpha-Phase Boundary in the Copper-Tin System.** — (*Metallurgist* (Suppt. to *Engineer*), 1935, 10, 30-32).—A summary and discussion of a paper by T. Isawa and I. Obinata on "X-Ray Investigations on Tin-Bronzes," *Metallwirtschaft*, 1935, 14, 185-188; see *Met. Abs.*, this volume, pp. 56, 289.

—R. G.

**\*The Constitution of the Lithium-Bismuth Alloys.** E. Zintl and G. Brauer (*Z. Elektrochem.*, 1935, 41, 297-303).—In agreement with the results of thermal analysis and conductivity measurements of Grube, Vosskühler, and Schlecht, 2 stable intermediate phases were found by X-ray analysis in this system at ordinary temperatures. They contain 50 ( $\alpha$ -LiBi) and 75 atomic-% of lithium ( $\text{Li}_3\text{Bi}$ ), and have a range of homogeneity of undetectable dimensions.  $\text{Li}_3\text{Bi}$  is cubic ( $a = 6.708$  A.) with 16 atoms per cell; face-centred lattices begin at 0 0 0 (Bi),  $\frac{1}{2} \frac{1}{2} \frac{1}{2}$ ,  $\frac{1}{2} \frac{1}{2} \frac{1}{2}$ ,  $\frac{3}{4} \frac{3}{4} \frac{3}{4}$  (Li).  $\alpha$ -LiBi has a tetragonal space-centred structure like the previously described NaBi, with  $a = 3.361$  A.,  $c = 4.247$  A.,  $c/a = 1.264$ ; Bi in 0 0 0, Li in  $\frac{1}{2} \frac{1}{2} \frac{1}{2}$ . The tetragonal lattices of  $\alpha$ -LiBi and NaBi arise from the  $\beta$ -brass lattice by distortion, in which the bismuth atoms are brought together in planes parallel to the basic plane by mutual contact.—J. H. W.

**\*The Constitution of the Lithium-Cadmium Alloys.** E. Zintl and A. Schneider (*Z. Elektrochem.*, 1935, 41, 294-297).—The existence of 4 intermediate forms of crystals has been found in the lithium-cadmium system by X-ray analysis, in agreement with the thermal analysis and conductivity and dilatometric measurements of Grube, Vosskühler, and Vogt. One of these



phases ( $\beta$ ) exists only at higher temperatures and has possibly cubic symmetry. The  $\beta'$  phase, with range of homogeneity about 25 atomic-% of lithium, corresponding to the formula  $\text{LiCd}_3$ , has the most closely-packed hexagonal structure ( $a = 3.083 \text{ \AA}$ ,  $c = 4.889 \text{ \AA}$ ,  $c/a = 1.586$ , 2 atoms per cell), with static distribution. The mixture-phase (*Mischungsstücke*) between  $\beta'$  and cadmium saturated with lithium ( $\alpha$ -phase) shows two different types of hexagonal packing, the axial ratio of the one being over 1.8, and that of the other being 1.63 (the ideal ratio of the closest spherical packing). The  $\gamma$ -phase ( $\text{LiCd}$ ) has a space-centred structure of the  $\text{NaTl}$  type ( $a = 6.687 \text{ \AA}$ ). Alloys with a lithium content of about 75 atomic-% consist of crystals ( $\gamma'$ ) with a face-centred cubic lattice and static atomic arrangement ( $a = 4.250 \text{ \AA}$ ).—J. H. W.

**\*A Manganese-Silicon Alloy with the Tungsten (A2) Type of Structure.** Fritz Laves (*Z. Krist.*, 1934, **89**, 189–191).—Borén (*Met. Abs.*, 1934, **1**, 178), who worked with pure vacuum-distilled manganese, found X-ray evidence for the compounds  $\text{Mn}_3\text{Si}$  and  $\text{MnSi}$ , but not for the additional compound  $\text{Mn}_5\text{Si}_3$  claimed by Vogel and Bedarff (*Met. Abs.*, 1934, **1**, 295), who examined less pure alloys by thermal and microscopic methods. The alloys used by Vogel and Bedarff have been examined by X-ray crystal analysis, which shows that the  $\text{Mn}_5\text{Si}_3$  phase of Vogel and Bedarff is identical in structure with the  $\text{Mn}_3\text{Si}$  phase of Borén, which is hexagonal. The  $\text{Mn}_3\text{Si}$  phase of Vogel and Bedarff has a body-centred cubic lattice with  $a = 2.85 \pm 0.01 \text{ \AA}$ , and a random distribution of atoms. These discrepancies are probably due to the impurity (about 3%, chiefly oxide, iron, and aluminium) in the alloys of Vogel and Bedarff.—W. H.-R.

**The Nature of Twinning Planes.** E. G. Ananiaschwili and D. B. Gogoberidse (*Physikal. Z. Sowjetunion*, 1934, **6**, 184–185).—[In German.] It is suggested that in the process of twinning the crystal lattice is not materially altered, and that very fine crystalline material is present in interstices between the twins.—J. S. G. T.

**†\*The Mechanical Properties and the Real Structure of Crystals.** E. Orowan (*Z. Krist.*, 1934, **89**, 327–343).—The discrepancies between the theoretical and actual strengths of crystals are described, and the different theories discussed critically. Many examples of the great effect of surface cracks or flaws are described, and it is shown how weakness in plastic deformation can be accounted for without assuming the existence of a very deep crack. O. concludes that theories of secondary mosaic or block structures are unnecessary, and that all the effects can be ascribed to the presence of flaws.

—W. H.-R.

**\*New Evidence, Setting an Upper Limit of 500 Å. or Less, to Dimensions of Mosaic Blocks (if Any) in a Crystal.** Harold E. Buckley (*Z. Krist.*, 1934, **89**, 410–415).—[In English.] Optical interference effects have been observed for light reflected between the opposite parallel faces of many crystals, and these require a degree of perfection which is difficult to reconcile with the existence of block structures with dimensions of the order 10,000 Å. B. concludes that a block structure is not a fundamental characteristic of a crystal.—W. H.-R.

**†The Theory of Real Crystals.** Adolf Smekal (*Z. Krist.*, 1934, **89**, 386–399).—A review of experiments on the structure-sensitive properties of crystals, especially of rock-salts, and of S.'s theories of flaws in crystals.—W. H.-R.

**†Some Applications of X-Ray Crystallography to Industry.** J. T. Randall and H. P. Rooksby (*G.E.C. Journal*, 1934, **5**, 189–196).—The underlying principles of the subject are briefly explained, and illustrations are given of industrial applications covering such subjects as the behaviour of refractory materials, manufacture of glass, wire-drawing, radio valves, and hot cathode discharge tubes.—S. V. W.

## IV.—CORROSION

(Continued from pp. 291-296.)

**What May Not Be Made With Aluminium?** Richard Schulze (*R.T.A. Nachr.*, 1935, 15, (21), 3-4).—Pure aluminium may be distinguished from aluminium alloys by dipping the metal in 10-20% caustic soda. The conditions in which aluminium should not be worked into tubes, armatures, screwed joints, &c., because of the danger of corrosion, are discussed.

—B. Bl.

†**Basic Copper Carbonate and Green Patina.** W. H. J. Vernon (*J. Chem. Soc.*, 1934, 1853-1859).—S. V. W.

\***On Hardenable Bronzes on a Nickel-Copper-Tin Base.** IV.—**Influence of Precipitation-Hardening on the Resistance to Corrosion.** E. Fetz (*Korrosion u. Metallschutz*, 1935, 11, 100-107).—The resistance to corrosion of copper-rich alloys containing nickel and tin has been determined in 3% nitric acid, and in 3 and 10% hydrochloric acid after different heat-treatments and in conditions of total immersion with free access of air in stationary media. The rate of dissolution of precipitation-hardened alloys in nitric acid is greater the greater is the amount of the new phase precipitated in a highly dispersed form; with progressive coagulation of the disperse phase the resistance to corrosion approaches that of the annealed metal. In 3% hydrochloric acid the hardened alloys become coated with a compact protective layer which reduces the rate of attack below that of homogenized alloys; a similar effect is obtained in 10% hydrochloric acid, but the protective layer is not so adherent. The presence of oxidizing agents accelerates corrosion in hydrochloric acid. Annealed alloys of the ternary system show approximately the same resistance to corrosion as the binary alloy of copper and the predominating element; with increase in nickel content the resistance to nitric acid decreases and that to hydrochloric acid increases. No appreciable deterioration of the mechanical properties of the 7.5 : 8 : 86.5 nickel-tin-copper alloy occurs after exposure for a month to running aerated sea-water under static loads.—A. R. P.

\***The Electrolytic Corrosion of Lead Cable-Sheath.** Masaie Horioka and Takao Kyogoku (*J. Inst. Teleg. Teleph. Eng. Japan*, 1932, (106), 37-57).—[In Japanese.] See *Met. Abs. (J. Inst. Metals)*, 1933, 53, 21.—S. G.

\***A Simple Method for Determining the Electrolysis of Lead Cable.** Masaie Horioka and Takao Kyogoku (*J. Inst. Teleg. Teleph. Eng. Japan*, 1932, (107), 254-257; *Jap. J. Eng. Abs.*, 1935, 12, 30).—[In Japanese.] Chemical analyses were carried out to ascertain whether the corrosion of lead cable-sheath is or is not due to electrolysis, and also to test the presence of lead peroxide on the cable surface. Chemical analysis in this field is difficult. Since in most electrolysis surveys qualitative analysis is sufficient, a very simple method was devised, in which an acetic acid solution of tetramethyl *p-p'*-diaminophenyl-methane is poured over the lead surface, when the presence of lead peroxide is clearly indicated by a deep blue colour. The same result may be obtained with an acetic acid solution of benzidin  $\text{NH}_2\cdot\text{C}_6\text{H}_4\cdot\text{C}_6\text{H}_4\cdot\text{NH}_2$ . These solutions also indicate, by colouring, traces of lead ions in the soil around the concrete duct, through which the lead ions ooze out by electrolysis into the surrounding soil, thus rendering it possible to obtain, from outside, a rough idea of electrolysis of the cable-sheath enclosed in the concrete duct.—S. G.

**On the Corrosion of Type Metal in Contact with Red Beechwood.** Bruno Schulze (*Z. deut. Buchdrucker verwandte Gewerbe*, 1934, 46, 880-881; *Chem. Zentr.*, 1935, 106, I, 786).—Type metal stored in red beechwood boxes frequently becomes severely corroded, especially if the boxes are new. This is attributed to vapours of volatile organic acids, probably acetic acid, evolved from the wood.—A. R. P.

**\*On the Topochemistry of Metallic Magnesium (A Contribution to the Knowledge of Metallic Corrosion).** Antonín Vyskočil (*Chem. Listy*, 1934, 28, (15-16), 201-207).—See *Met. Abs.*, 1934, 1, 303.—R. P.

**The Corrosion of Magnesium.** L. Whitby (*Korrosion u. Metallschutz*, 1935, 11, 88-89).—Polemical against Kroenig and Pavlov (cf. *Met. Abs.*, this volume, p. 60). The statement that hydrogen is evolved from inclusions in magnesium alloys during corrosion is contradicted by the work of Vernon and Whitby. The protective action of manganese in magnesium alloys is attributed to the formation of films with a high cathodic overvoltage and not to the formation of protective films with a high content of manganese hydroxide. —A. R. P.

**On the Corrosion of Magnesium Containing Manganese.** W. Kroenig and S. Pavlov (*Korrosion u. Metallschutz*, 1935, 11, 89).—A reply to Whitby (preceding abstract). K. and P. maintain their previous interpretation of the observed phenomena.—A. R. P.

**Inconel: An Alloy for Textile Wet-Processing Equipment.** F. L. La Que (*Amer. Dyestuff Reporter*, 1935, 24, 114-119; *C. Abs.*, 1935, 29, 3284).—Inconel contains (approximately) nickel 80, chromium 14, and iron 6%, and is resistant to a very wide variety of acid and alkali corrosives. Mechanical and physical properties of the alloy are tabulated, and also the rates of corrosion in hydrochloric, sulphuric, and nitric acid solutions of various strengths. Hypochlorite solutions are less corrosive to Inconel than to Monel metal, though it should not be used in continuous contact with chlorine bleaching solutions of any strength.—S. G.

**\*The Properties of Zinc of Exceptional Purity Compared with those of Other Specimens of Zinc.** Louis Bouchet (*Compt. rend.*, 1935, 200, 1535-1537).—A comparison has been made experimentally between the action of redistilled water and chemically pure acid solutions on a specimen of very pure zinc containing, according to spectroscopic analysis, not more than 0.0001% of impurities, with that on other specimens of fineness from commercial purity up to 99.995%. (1) 15% hydrochloric acid: after immersion for 5 hrs., the purest zinc lost 2.2% of its weight, the loss increasing with the amount of impurity up to 25% for 99.978% zinc; (2) 20% sulphuric acid: the action was similar, but to a smaller extent; (3) concentrated nitric acid (40° Bé): the extra pure zinc rapidly dissolved with the evolution of copious nitrous fumes, while commercial zinc lost only  $\frac{1}{4}$  of its weight in 10 minutes; (4) redistilled water (conductivity =  $0.95 \times 10^{-6}$ ,  $p_H = 5.9$ ): the extra pure zinc appeared to increase slightly in weight, but this may have been due to experimental errors; the other specimens all corroded in the same manner as (1) and (2), but to a smaller extent. The action of nitric acid can be explained by the tendency of certain impurities to cause passivity, and by secondary reactions which may be represented by the equation:  $9\text{HNO}_3 + 4\text{Zn} = 4\text{Zn}(\text{NO}_3)_2 + 3\text{H}_2\text{O} + \text{NH}_3$ . It should be possible to estimate the amount of impurities in zinc by the rate of solution of the metal in the appropriate liquid. —J. H. W.

**Tube Corrosion.** F. J. Bullen (*Metallurgist (Suppt. to Engineer)*, 1934, 9, 183-186).—See also *Met. Abs.*, this volume, p. 162. Cases of corrosion are described in which the perforation of tubes was attributable to the presence of oil inside. In one case the same type of tube had been used in condensers in the same power station with success, and the reason for its failure in an oil cooler (cooling water inside) was obscure until extraction of the scale deposit with ether showed the existence of oil. The faulty fitting of the tube in the end-plates had been initially responsible for the failures. The effect of a drop of oil settling on the tube surface is to set up corrosion by differential



aeration. This was confirmed by laboratory experiments. Similar features were shown by tubes from an oil-tanker, and in the case of failures occurring in motor lifeboats the introduction of oil was traced to the impregnation of the tape with oil prior to packing. Oil was thus present in the water outside the tubes and tended to settle on the top surface. Illustrations of corroded tubes are shown. The detection of oil as the direct cause of tube failures is seldom easy, but it may exist long enough to initiate local corrosion which then proceeds independently.—R. G.

**\*The Control of Corrosion in Air-Conditioning Equipment by Chemical Methods.** C. M. Sterne (*Amer. Soc. Test. Mat. Preprint*, 1935, June, 1-10).—Corrosion attack of the metallic parts of air-conditioning systems can be so severe that perforation of ferrous sheets and pipes may take place in as short a time as 4 months if the wash water or condenser water is not chemically treated. Practically every type of corrosion attack is common to these systems. Service corrosion tests and analyses of the recirculated water show very clearly the causes and degree of severity of that attack. The tests also show the degree of protection that may be obtained by proper chemical treatment. S. has carried out corrosion tests in over 200 separate air-conditioning systems, handling both comfort and industrial conditioned spaces in many types of industry and in various cities throughout the United States; representative cases are reported in this paper. Check examinations of these systems by the author and others have shown conclusively that by proper chemical treatment and supervision the corrosion attack may be reduced to a minimum.—S. G.

**\*Propeller Cavitation.** Yoshiyuki Amari (*Journal of Zosen Kiokai (Soc. Naval Arch. Japan)*, 1932, 49, 153-161).—[In Japanese.] After discussing the causes and nature of the various kinds of cavitation of marine screw propellers, A. describes his own method for dealing with the effect of cavitation on propeller design. The principle of the "thrust indicator," which is the most convenient apparatus for the study of the cavitation problem, is explained. Some results of experiments on cavitation are given in the appendices to the paper.—S. G.

**\*The E.M.F. Between Metals in Sea-Water.** J. W. Willstrop (*Aeronaut. Res. Cttee., R. and M. No. 1611*, 1934, 9 pp.; and (summary) *Light Metals Research*, 1935, 3, 340-342).—The potentials of various metals and alloys against the *N*-calomel electrode in sea-water have been determined at 25° and 40° C. 18:8 chromium-nickel steel and Monel metal have the most positive potentials, and these are followed in order by brasses and bronzes, Duralumin, and copper-aluminium alloys, ordinary steels, aluminium alloys free from copper, cadmium, zinc, and magnesium.—A. R. P.

**Corrosion-Testing Methods.** H. E. Searle and F. L. La Que (*Amer. Soc. Test. Mat. Preprint*, 1935, June, 1-12).—Attention is directed to the practical advantages of field corrosion tests as an aid in selecting materials to be used in equipment that must resist corrosion. A simple and inexpensive device is described that has broad application in field corrosion testing. Based on 8 years of experience in the use of this and other devices, it is considered to be the most practical yet developed. Examples are given to illustrate the accuracy with which performance in service has been predicted through its use. It is suggested that standardization of apparatus for field corrosion testing will be of greater utility than a similar standardization of laboratory testing equipment.—S. G.

#### CORROSION-RESISTANT MATERIALS.

**Materials Recommended for Oil-Refinery Pumps.** A. E. Harnsberger (*Chem. and Met. Eng.*, 1935, 42, 144-145).—Bronze is used for casings and impellers of centrifugal reflux pumps in severe corrosive conditions, and for casing wearing rings, in addition to Monel metal and Stellite steel. Hard,

acid-resistant bronze is sometimes used for shaft sleeves. In the case of centrifugal pumps for absorption plants, leaded-bronze impellers, fitted with Stellite iron rings are used where corrosive conditions are not severe. Acid-resistant bronze or Monel metal will give fair service on all parts of centrifugal pumps dealing with sludge acid. Acid-resistant bronze or red brass is usually employed for liners and fluid ends of reciprocating acid pumps; bronze and Monel metal for piston-rings, rods, valves and valve seats. Rotary acid pumps usually have acid-resistant bronze cases and shafts or rotors of the same material or Monel metal. Sometimes bronze rotors are combined with a Tempalloy shaft. Other pumps may have hard lead cases with Illium rotors and shafts. Bronze parts should be avoided in the presence of caustic soda.

—F. J.

[Corrosion-Resistant] Construction Materials. James A. Lee (*Chem. and Met. Eng.*, 1935, 42, 225-227).—An interesting review of the early discovery and applications of corrosion-resistant materials of construction, with chief reference to the common metals.—F. J.

F.M. Alloy Resistant to Hydrochloric Acid. H. Oettinger (*Ind. chim. belge*, 1934, [ii], 5, 319).—The alloy (nature not stated) is said to be practically unattacked by 17% hydrochloric acid or by 40% hydrofluoric acid at 75° C. An elaborate large-scale apparatus constructed of the alloy is illustrated.

—A. R. P.

## V.—PROTECTION

(Other than Electrodeposition.)

(Continued from pp. 296-298.)

Polishing as a Protection Against Corrosion. — Plücker (*R.T.A. Nachr.*, 1934, 14, (39), 4).—Increase in the corrosion-resistance of metals by polishing is briefly discussed.—B. Bl.

Protection of Cables from Electrolytic Corrosion by Means of Low Single Potential Metallic Plates. Koei Sasaki (*J. Inst. Teleg. Teleph. Eng. Japan*, 1932, (113), 1056-1079).—[In Japanese.]—S. G.

Zinc Ammonium Chloride. Its Place in Modern Galvanizing. H. G. Hobbs (*Iron Age*, 1935, 135, (21), 10-13, 84; (22), 6, 8, 90).—The history of zinc up to the time of hot-dip galvanizing, the subsequent growth and mechanism of the hot-dip process, and the various applications in the galvanizing industry of hydrochloric acid, ammonia, zinc chloride, and sal ammoniac are reviewed. Modern practice is described and the advantages and disadvantages of zinc ammonia chloride as against sal ammoniac and hydrochloric acid are summarized.—J. H. W.

†Determination of the Thickness of Metallic Protective Layers. Alexander Glazunov (*Chem. Listy*, 1934, 28, 302-305, 313-315).—Methods of determining the value of protective metallic coatings are critically reviewed. Two types of coatings are in general use: (a) in which the coating metal is more electropositive, and (b) in which it is more electronegative than the metal base. G.'s method of evaluating coatings consists in making the coated metal the anode in a solution of a salt of the coating metal and plotting current density-time curves, from the steps in which the thickness of the various layers can be calculated. In coatings of type (a) the minimum film thickness can also be determined; i.e. an indication obtained of the porosity; this is obtained by adding to the electrolyte an indicator which reacts with the basis metal but not with the plate. The minimum thickness is calculated from the time taken and the current used before a reaction is obtained with the indicator. With porous plates this occurs soon after the beginning of the electrolysis.

—R. P.

**Protecting Machine Parts by Metal Spraying.** Harold B. Veith (*Machine Design*, 1935, 7, (2), 28-29).—A brief account of the metal spraying process with notes on the characteristics of sprayed coatings is illustrated with several examples showing the value of such coatings as a protection against corrosion. Spraying of cast-iron impellers and pump cases, used in iodine manufacture, with a 0.01 in. coating of Monel metal and a 0.01 in. coating of 6% antimony-lead alloy prolonged the life from 6 weeks to 8 months. Cheese mixing tanks are sprayed first with zinc, then with tin.—A. R. P.

**Metallizing in Canada.** R. S. Tuer (*Iron Steel Canada*, 1935, 18, 26-27).—The advantages and applications of metallizing, which account for the rapid advance of the process in Canada, are briefly summarized.—J. H. W.

**Lanolin Rust Preventers.** C. Jakeman (*Dept. Sci. Indust. Res., Eng. Research Special Rep. No. 12*, 1934, 26 pp.).—Bright steel parts may be kept free from rust during storage by painting them with a solution containing about 8 lb. of partially refined lanolin per gall. of white spirit or solvent naphtha.  
—A. R. P.

## VI.—ELECTRODEPOSITION

(Continued from pp. 298-302.)

**Tentative Specifications for Electrodeposited Coatings of Cadmium on Steel.** Anon. (*Monthly Rev. Amer. Electroplaters' Soc.*, 1935, 22, (5), 7-9).—A minimum thickness of 0.0005 in. of cadmium is specified for general service, and of 0.00015 in. for mild service.—A. R. P.

**\*The Electrodeposition of Alloys of Copper and Tin.** Charles Béchard (*Compt. rend.*, 1935, 200, 1737-1739).—The method of depositing an alloy of predetermined composition by means of anodes of the 2 pure metals in short circuit (*J. Inst. Metals*, 1933, 53, 446) is not applicable to copper-tin alloys. The solutions usually used consist of a mixture of complex oxalates of tin and ammonia and of copper and ammonia, and a piece of tin immersed in this solution spontaneously displaces copper, especially if it is short-circuited with copper. A relatively high current density (5-10 amp./dm.<sup>2</sup>) is required for the deposition of the alloy. A light amalgamation of the tin anode will regularize the anodic attack without adversely affecting the composition of the bath or the quality of the deposit. On the other hand, the anodic solution of the copper requires a low current density (0.5 amp./dm.<sup>2</sup>), otherwise the anode will disintegrate, giving a rough deposit. The use of bimetallic anodes does not fulfil these conditions as in the case of the deposition of brass. Three independent electric circuits are therefore used. The principal circuit contains the cathode on which the alloy is to be deposited and an *insoluble* carbon anode. The regeneration of the bath is effected by 2 auxiliary circuits in which the anode is the metal to be dissolved (copper or tin), the cathode corresponding to each of these 2 anodes being placed in a porous pot filled with a solution only evolving hydrogen. The 3 circuits have separate sources of current and can, therefore, be independently controlled. An alkaline bath of tin (? sodium) stannate and potassium copper cyanide has also been used, and no displacement of copper by tin was observed, even when the tin was short-circuited with copper, but the anodic attack of the tin remained insufficient. To obtain a satisfactory solution of the tin, pure metal anodes were connected in parallel, after connecting each of them in series with a variable resistance and a milliammeter, a simple current supply being used.—J. H. W.

**Brass Electrodeposits for Intermediate Coats.** A. Braun (*Oberflächentechnik*, 1935, 12, 39-42).—Brass undercoatings are more satisfactory than copper since they give better resistance to corrosion and the outer plated coating is much smoother and brighter. From cyanide baths addition of ammonia or



phenol brighteners permits bright brass plates to be obtained over periods of up to 40 minutes; these adhere well to zinc, iron, tin, and, if the metal is previously dipped in a zincate bath, aluminium. A final nickel plate affords adequate protection against corrosion in all cases. The composition of the brass plating bath is discussed at some length with especial reference to the value of brighteners.—A. R. P.

**The Electrodeposition of Chromium.** E. A. Ollard (*Met. Ind. (Lond.)*, 1935, 46, 541-542).—The theoretical considerations involved in the use of a bath of chromic acid containing a small quantity of sulphate, the formation of sulphate, the mechanism of the reaction, cathode reactions, and the importance of the sulphate content are discussed from the practical point of view.

—J. H. W.

**\*Crystallization Centres in the Cathodic Deposition of Gold (Electrolysis under the Microscope.—X).** Alexander Glazunov and B. Honza (*Chem. Obzor*, 1934, 9, 124-126).—Deposits obtained from gold chloride solutions are lustrous and compact so that the rate of crystallization cannot be measured when the number of crystallization centres is large. At a high current density the deposit is first compact, then the gold is deposited in the form of a greenish or red powder. In acid solutions a very high current density is required to produce powdery deposits. Addition of organic substances favours the formation of compact, glistening deposits. Similar observations have been made in the deposition of palladium from palladous chloride solutions.—R. P.

**Tentative Specifications for Electrodeposited Coatings of Nickel and Chromium on Steel.** — (*Monthly Rev. Amer. Electrodepositors' Soc.*, 1935, 22, (5), 9-13).—For steel plating two grades of deposit are specified: (a) to withstand the salt-spray for 48 hrs. the undercoat should consist of a minimum thickness of 0.00075 in. of copper and nickel of which at least the last 0.0004 in. is nickel, (b) to withstand the spray for 16 hrs. the minimum thickness of the undercoat should be 0.0004 in. of which the last 0.0002 in. is nickel. In both cases the final chromium coat should be at least 0.00002 in. thick.—A. R. P.

**The Influence of Additions to the Nickel Bath on the Deleterious Effect of Iron Therein.** E. Raub (*Mitt. Forschungsinst. Edelmetalle*, 1935, 9, 1-8).—Essentially the same as a paper by Raub and Walter, *Z. Elektrochem.*, 1935, 41, 169; cf. *Met. Abs.*, this volume, p. 237.—A. R. P.

**Determination of the Thickness of the Deposit on Nickel Plated Wires by Glazunov's Method.** V. Peták and F. Honzík (*Chem. Obzor*, 1934, 9, 104-107).—Electrodeposits consist of a layer of the plated metal above a thin layer of an alloy of this metal with the basis metal produced by diffusion. The thickness of these layers can be determined, according to Glazunov, by anodic dissolution and observation of the potential and current density, which remain constant until the outer layer has completely dissolved and then change consistently until the basis metal is reached. From the current density and time of dissolution at each stage the thickness of the 2 layers can be calculated. Good results are obtained on nickel-plated copper.—R. P.

**Nickel Anodes.** A. Barattini (*Industria meccanica*, 1935, 17, 9-12; *C. Abs.*, 1935, 29, 3239).—The points of view which should determine the selection of nickel anodes are discussed. Cast anodes, even if sufficiently pure, have a low efficiency, because they disintegrate irregularly on account of their porosity and leave undissolved much non-recoverable scrap. Bright, rolled alloys are also not very suitable, as they become passive readily. Annealed rolled alloys with mechanically roughened surfaces go into solution uniformly and give a much higher anode efficiency than the 2 types of anode mentioned above. They are suitable for concentrated baths with medium current density. Anodes cut from nickel-refinery cathodes are serviceable provided that the  $\text{Cl}^-$  content of the bath is regulated.  $\text{Cl}^-$  addition is recommended for all anodes in operating with high and medium current densities.—S. G.

**Silver Plating to Specifications.** C. B. F. Young and S. C. Taormina (*Met. Ind. (N.Y.)*, 1935, 33, 165-167).—The results of experiments are cited which show that silver can be plated to specification provided that the solution is maintained to a standard by periodic analysis, the work is distributed as regularly as possible with respect to the anodes, similarly shaped and sized articles are plated together, and the current density is regulated by means of a pilot. Allowance must be made for the amount of silver removed in the final buffing operation; this averages, for well-plated articles, about 10% of the total amount deposited.—A. R. P.

**\*Electrodeposition of Silver from Iodide Solutions.** Charles W. Fleetwood and L. F. Yntema (*Indust. and Eng. Chem.*, 1935, 27, 340-342).—A quantitative study of a bath containing citric acid 60 and sodium iodide 520 grm./litre, using a silver anode, showed that the deposit is fine-grained and adherent. No quantitative study was made of the throwing power, but there appeared to be uniform deposition even on irregularly-shaped articles. The permanency of the bath is indicated by the fact that it gave as good deposits after standing exposed to the atmosphere for 4 months as when newly prepared. The anode corrosion is good. When operated at cathode efficiencies of 80% and higher, the silver content of the bath is increased. The bath is easily prepared.—F. J.

**Tentative Specifications for Electrodeposited Coatings of Zinc on Steel.** — (*Monthly Rev. Amer. Electroplaters' Soc.*, 1935, 22, (5), 4-6).—For general service the minimum thickness of zinc shall be 0.0005 in. and for mild service 0.00015 in.—A. R. P.

**The Electro-Deposition of Metals.** H. Moore (*Metallurgist (Suppt. to Engineer)*, 1934, 9, 191-192).—A brief survey of the organization of research work on electrodeposition carried out in Great Britain, and a description of some of the results of work on pitting, adhesion, and properties of electrodeposits. Recent changes in control of the researches, and the need for further work for which the support of industry is necessary, are discussed.

—R. G.

## VII.—ELECTROMETALLURGY AND ELECTROCHEMISTRY

(Other than Electrodeposition.)

(Continued from p. 302.)

**\*Researches on the Electrolysis of Metals During the Simultaneous Scraping of Anode and Cathode by a Diamond.** J. Gillis and J. Swenden (*Rec. trav. chim.*, 1935, 54, 219-234).—The electrodes used were 2 wires, arranged so as to be scraped simultaneously by a diamond. It was found that with low concentrations of normal salts of copper, nickel, cadmium, and mercury, using scraped electrodes of the same metal (dropping electrodes for mercury), there is a straight-line relation between the potential difference and the current density. For copper and nickel the straight-line relation gives place to a logarithmic curve above a certain concentration of the bath. For all the straight-line curves the relation between the polarographic resistance  $r$  and the concentration  $c$  is given by:  $\log f = a + b \log c$ . The factor  $f$  is the ratio of the polarographic resistance to the resistance of the electrolyte; its value is small for metals of low polarization, and high for metals of high polarization.

—C. E. H.

**\*Mechanism of Conductance.** Hiram S. Lukens (*Electrochem. Soc. Preprint*, 1935, Mar., 317-324).—Lines of equipotential in the solution between 2 electrodes of the same and of differing contour have been mapped out by a new method involving the use of an exploratory auxiliary electrode. The results show that whenever 2 electrodes in contact with an electrolyte are polarized

the electric field established produces a state of stress which is characterized by a potential drop between *all* parts of the electrolyte and the electrodes. The bearing of this on accepted theories of conductance is briefly discussed.

—A. R. P.

## IX.—ANALYSIS

(Continued from pp. 303–305.)

**The Rôle of the Spectrograph and of Minor Elements in Die-Castings.** Thomas A. Wright (*Metals Technology*, 1935, 2, A.I.M.M.E. Tech. Publ. No. 614, 1–9).—W. refers briefly to the effects of some impurities in Al, Zn, white metal, Mg, and brass alloys used for die-castings, and indicates possible sources of contamination, and the advantages of spectrographic analysis.

—W. H. R.

**\*Quantitative Spectrographic Analysis of Calcium and Barium in Light Alloys and Solutions, and Various Influences on the Emission of Rays.** Henri Triché (*Compt. rend.*, 1935, 200, 1665–1667).—An account of investigations under the auspices of the Service technique et des Recherches de l'Aéronautique. Equal intensity of the lines 3933·67 Ca<sup>+</sup> and 3891·78 Ba<sup>+</sup>, using a gold or, better, pure aluminium electrode, is obtained with a weight ratio,  $\frac{\text{Ba}}{\text{Ca}} = 130$ . This method gives Ca to  $\frac{1}{1000}$  in alloys and  $\frac{1}{100000}$  in solutions. For greater rapidity and absolute sensitivity, a spark is passed between an alloy containing Ca and a solution containing only BaCl<sub>2</sub>. This method has the advantage of not destroying the alloy, but the conditions are well-defined. Taking the intensity of the Ca line as unity, the intensity of the Ba line has been studied as a function of (1) the temperature of the solution, to which it is proportional between 0°–60° C., a rise of 5° C. producing an increase of intensity of 10%, (2) the concentration of HCl—the intensity increases initially in proportion to the number of drops introduced into the solution, and then more slowly until the chloride becomes insoluble. The intensity increases equally with the current in the primary of the transformer, but all measurements were, in fact, made with a constant current. These results can be explained by the increase of the conductivity of the solution and thus by that of the spark, and probably by the lowering of the surface tension. Surface tension appears to play a complex part in the mechanism, and its action was investigated by adding to the solution various active organic substances which had little effect on the conductivity of the solution. A method of rapidly obtaining equality of intensity is described.—J. H. W.

**Possible Use of the Poulsen Arc as a Means of Detecting Traces of Impurities in Metals.** Harry E. Redeker and Philip A. Leighton (*J. Amer. Chem. Soc.*, 1930, 52, 4169–4170).—A letter.—I. M.

**\*A Magneto-Optic Method of Chemical Analysis.** Fred Allison and Edgar J. Murphy (*J. Amer. Chem. Soc.*, 1930, 52, 3796–3806).—See *J. Inst. Metals*, 1930, 43, 540.—I. M.

**The Recognition of Platinum and Palladium and the Distinction of Platinum, Palladium, and White Gold Alloys from Base Metal Alloys Resembling Platinum.** Karl Bihlmaier (*Mitt. Forschungsinst. Edelmetalle*, 1935, 8, 131–137).—Physical and chemical tests for Pt and Pd in alloys, residues, and solutions are described briefly.—A. R. P.

**\*Separation of Aluminium from Nickel and Cobalt by Means of Hydrazine Carbonate.** A. Jilek and J. Vřestál (*Chem. Listy*, 1934, 28, 113–115).—Double precipitation of the Al with N<sub>2</sub>H<sub>4</sub>·H<sub>2</sub>CO<sub>3</sub> serves to effect or complete separation from Ni and Co. Ignition of the precipitate affords pure Al<sub>2</sub>O<sub>3</sub>.—R. P.

**\*Method for Separating Iron and Cobalt Quantitatively.** Pierre Spacu (*Compt. rend.*, 1935, 200, 1595–1597).—To the hot neutral or feebly acid solu-



tion of the 2 metals (the Fe being oxidized by boiling with a few drops of  $\text{HNO}_3$ , if necessary), pyridine is added drop by drop until all the Fe is precipitated and the solution remains clear, 3–4 drops in excess being added. The precipitate is filtered, washed with hot water, ignited and weighed as  $\text{Fe}_2\text{O}_3$ . To ensure that the  $\text{Fe}(\text{OH})_3$  has not adsorbed traces of Co, it can be redissolved in  $\text{HCl}$  and reprecipitated with pyridine. The Co can be determined in the solution direct in the form of the amine,  $\text{CoPy}_3(\text{SCN})_2$ , by the method described by G. Spacu (*J. Inst. Metals*, 1927, 38, 510).—J. H. W.

**\*Electrolytic Determination of Cadmium.** Jan Šebor (*Chem. Listy*, 1934, 28, 290–291, 297–299).—Quantitative deposition of cadmium as a bright plate is obtained from a stirred electrolyte containing  $\text{K}_2\text{C}_2\text{O}_4$  12,  $\text{CH}_3\text{-CO}_2\text{Na}$  3 grm., and 20%  $\text{CH}_3\text{-CO}_2\text{H}$  3 c.c. in 120 c.c. of water using a current of 0.2 amp. at 2.9 v. at 70°–80° C. Up to 0.16 grm. of Cd can thus be deposited, and up to 0.24 grm. if 0.25 grm. of  $\text{C}_6\text{H}_5\text{OH}$  is added to the electrolyte. In the latter case the deposit becomes crystalline, the time of deposition is trebled, and the solution becomes brown owing to formation of quinone. Using a current of 0.1 amp. Cd can be separated completely from Zn.—R. P.

**\*A Study of the Quantitative Precipitation of Calcium Oxalate in the Presence of the Arsenate Ion.** J. T. Dobbins and W. M. Mebane (*J. Amer. Chem. Soc.*, 1930, 52, 4285–4288).—See also *J. Inst. Metals*, 1930, 44, 579. Accurate results may be obtained as follows: make the solution alkaline with  $\text{NH}_4\text{OH}$  and add a few drops in excess. Add excess  $(\text{NH}_4)_2\text{C}_2\text{O}_4$  to the boiling solution and keep this at incipient boiling temperature for 10 minutes with occasional stirring. After standing for 1 hr., filter off the precipitate, wash with distilled water containing a small amount of  $\text{NH}_4\text{OH}$ , transfer on the paper to the precipitation beaker, dissolve in 30 c.c. dilute  $\text{H}_2\text{SO}_4$ , dilute to 100 c.c., and titrate rapidly with 0.1N- $\text{KMnO}_4$  solution. The best temperature for precipitation is 90°–100° C.—I. M.

**Determination of Cobalt by Means of  $\alpha$ -Nitroso- $\beta$ -Naphthol.** Léon Philippot (*Bull. Soc. chim. Belg.*, 1935, 44, 140–153).—To avoid the usual difficulties in igniting the Co-naphthol precipitate P. recommends digesting it with fuming  $\text{HNO}_3$ , evaporating the solution with  $\text{H}_2\text{SO}_4$ , diluting and precipitating the Co with  $\text{KOH}$  and Br; the  $\text{Co}(\text{OH})_3$  is then dissolved in  $\text{H}_2\text{SO}_4$  and  $\text{H}_2\text{O}_2$ , and determined by electrolysis.—A. R. P.

**\*Studies on Heteropoly Acids of Germanium. I.—Germanomolybdic Acid.** Charles G. Grosscup (*J. Amer. Chem. Soc.*, 1930, 52, 5154–5160).—It is suggested that a new acid,  $\text{H}_8[\text{Ge}(\text{Mo}_2\text{O}_7)_6]$  aq., and its salts may be used for the colorimetric determination of Ge.—I. M.

**\*Nitrogen Compounds of Germanium. I.—The Preparation and Properties of Germanic Nitride.** Warren C. Johnson (*J. Amer. Chem. Soc.*, 1930, 52, 5160–5165).— $\text{Ge}_3\text{N}_4$  is readily reduced by  $\text{H}_2$  at 700° C. according to the equation  $\text{Ge}_3\text{N}_4 + 6\text{H}_2 = 3\text{Ge} + 4\text{NH}_3$ , and this reaction may be used for the analysis of Ge.—I. M.

**\*Sulphuric Acid Attack on Platinum-Gold-Silver Alloys and Its Importance in Cupellation (die Dokimasie).** K. W. Frölich (*Z. Elektrochem.*, 1935, 41, 207–211).—It is shown that the usual cupellation (*dokimatischen*) determination of Au and Pt is not sufficiently accurate. Errors in analysis are caused by the fact that boiling  $\text{H}_2\text{SO}_4$  can dissolve appreciable amounts of Pt as well as some Au. Although Pt is more resistant to concentrated  $\text{H}_2\text{SO}_4$  than Au at lower temperatures, at temperatures over 260° C. it becomes increasingly less resistant. A method of analysis is described which, by making use of the selective reducibility of  $\text{As}^{+++}$ , reduces the limits of error to from  $\frac{1}{2}$  to  $\frac{1}{4}$  for gold and from  $\frac{1}{10}$  to  $\frac{1}{20}$  for Pt of the errors by the older method. Using a solution in  $\text{H}_2\text{SO}_4$  corresponding to 0.5% of As and a Pt : Au ratio of not more than 1 : 10, the errors amount to about  $\pm 0.3$  per thousand for Au and  $\pm 3.0$  per thousand for Pt.—J. H. W.

**\*Estimation of Small Amounts of Lead in Copper.** Bartholow Park and E. J. Lewis (*Indust. and Eng. Chem. (Analyt. Edn.)*, 1935, 7, 182-183).—In the determination of traces of Pb in Cu by the spectrographic method a preliminary concentration of the Pb is necessary; this may be effected by dissolving 50 gm. of the Cu in  $\text{HNO}_3$ , adding a slight excess of  $\text{NH}_4\text{OH}$  followed by 2 c.c. of 50%  $\text{NaH}_2\text{PO}_4$  solution and 50 c.c. of 1:2  $\text{NH}_4\text{OH}$  saturated with  $\text{CO}_2$ , and collecting the  $\text{Pb}_3(\text{PO}_4)_2$  precipitate by adding an excess of  $\text{CaCl}_2$  solution to precipitate a mixture of  $\text{Ca}_3(\text{PO}_4)_2$  and  $\text{CaCO}_3$ . The mixed precipitate is collected, washed, and dissolved in  $\text{HCl}$ , the Pb and a small amount of Cu are precipitated with  $\text{H}_2\text{S}$ , and the sulphides are dissolved in  $\text{HNO}_3$  to give 5 c.c. of solution for spectrographing after absorption in a carbon electrode. The method will detect  $6 \times 10^{-7}$  gm. of Pb using the Pb line at 2833 Å. and comparing this with that given by a series of standards.—A. R. P.

**Note on the Volumetric Determination of Manganese.** J. Leroide and A. Bruiliet (*Bull. Soc. chim. France*, 1935, (v), 2, 740-742).—In the Volhard method of determining Mn by titrating the hot neutral  $\text{MnSO}_4$  solution with  $\text{KMnO}_4$  the addition of  $\text{ZnO}$  is unnecessary if a large quantity of  $\text{Na}_2\text{SO}_4$  or  $\text{K}_2\text{SO}_4$  is added to the solution. Much Fe or the presence of  $\text{Cl}^-$  interferes with the titration.—A. R. P.

**\*The Micro-Determination of Platinum and Iridium, and of Associated Chlorine and Potassium.** H. D. K. Drew, H. J. Tress, and G. H. Wyatt (*J. Chem. Soc.*, 1934, 1787-1790).—S. V. W.

**\*A New Volumetric Method for the Indirect Determination of Zinc.** G. Spacu and C. Gh. Macarovici (*Bul. Soc. Stiinta Cluj*, 1934, 8, 129-139; *Chem. Zentr.*, 1935, 106, I, 1422-1423).—The method depends on the precipitation of the Zn by addition of a known volume of 0.1N- $\text{NH}_4\text{CNS}$  solution and  $\text{C}_5\text{H}_5\text{N}$ , filtration of an aliquot part of the solution, and titration of the excess of  $\text{NH}_4\text{CNS}$  with  $\text{AgNO}_3$  after neutralization of the solution with  $\text{HNO}_3$ . —A. R. P.

**\*The Iodimetric Determination of Small Amounts of Zinc.** H. Armin Pagel and Oliver C. Ames (*J. Amer. Chem. Soc.*, 1930, 52, 3093-3098).—The iodimetric determination of small amounts of Zn, precipitated as zinc pyridine thiocyanate, has been developed. Data and the details of the procedure and technique are given.—I. M.

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

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

(Continued from p. 305.)

**On the Recent Development of Microscopy with Reflected Light.** F. Hauser (*R.T.A. Nachr.*, 1934, 14, (30), 3).—A microscope with various illuminating devices is described.—B. Bl.

**A Device for Measuring Irregular Areas.** — (*Eng. and Min. J.*, 1935, 136, (5), 259).—Describes an instrument based on the strip method of area determination. It consists of a transparent disc inscribed with a series of concentric circles calibrated in units of area.—R. Gr.

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

(Continued from pp. 305-306.)

**Ideas on the Standardization of Testing Methods.** P. Goerens (*R.T.A. Nachr.*, 1934, 14, (42), 1).—Points of view for an international standardization of methods of material testing are discussed.—B. Bl.

**The Inspection of Die-Castings.** R. W. P. Leonhardt (*Met. Ind. (Lond.)*, 1935, 46, 617-619).—The spectrographic and chemical analysis, shop-testing, X-ray and micrographic analysis, and the corrosion-resistance testing of die-castings are described.—J. H. W.

**†Position and Development of Non-Destructive Material Testing.** R. Bertold (*Z.V.d.I.*, 1935, 79, 477-484).—The principles of and apparatus for investigating the fine structure of metals with X-rays and various magnetic testing methods are described, and details are given of the filing and turning methods of examining metals.—K. S.

**\*A New Method for Investigating Solid Elastic Strains by Using Agar Jelly.** Tadayosi Kanao (*J. Soc. Mech. Eng. Tokyo*, 1933, 36, (195), 453-459; *Jap. J. Eng. Abs.*, 1935, 13, 8).—[In Japanese.] A study of volume strain, using specimens of agar jelly mixed with powdered graphite.—S. G.

**\*On Optical Creep in Photo-Elastic Phenomenon.** Kameiti Yuasa, Sinzi Hukui, and Tadasu Onisi (*J. Soc. Mech. Eng. Tokyo*, 1933, 36, (195), 447-452; *Jap. J. Eng. Abs.*, 1935, 13, 8).—[In Japanese.] An investigation of the time effect of the optical and strain creep of phenolite and celluloid tension specimens. The photo-elastic const. of phenolite is a function of time, and there are two different values for given stresses, it varies very quickly right after loading. There is no simple relation between optical and strain creep.—S. G.

**\*The Rotating-Wire Arc Fatigue Machine for Testing Small-Diameter Wire.** J. N. Kenyon (*Amer. Soc. Test. Mat. Preprint*, 1935, June, 1-9).—A stress-reversal machine developed on the principle of a rotating wire bent to arc curvature is being used to test small-diameter wire. Resonant vibrations or standing waves are damped in an oil-bath. The specimen automatically assumes the form of a circular arc by the elimination of flexural shear. Test results so far obtained give satisfactory values for small-diameter wire.

—S. G.

**\*High-Speed Fatigue Tests of Several Ferrous and Non-Ferrous Metals [Duralumin; Brass] at Low Temperatures.** W. D. Boone and H. B. Wishart (*Amer. Soc. Test. Mat. Preprint*, 1935, June, 1-6).—The authors present a group of low-temperature high-speed fatigue tests. Two cantilever fatigue machines, developed at the University of Illinois, using 12,000 r.p.m. series motors, were used in the tests. A description is given of the machines and their operation at temperatures that varied from  $+80^{\circ}$  to  $-55^{\circ}$  F. ( $27^{\circ}$  to  $-48^{\circ}$  C.). Two types of small inexpensive specimens were tested. Unnotched specimens were used to give maximum endurance limits for the materials, while notched specimens were used to show the effect of stress concentration. Endurance limits of Duralumin, brass, grey cast iron, manganite cast iron, cold-drawn steel, and rail steel were determined for unnotched and notched fatigue specimens for temperatures of  $+80^{\circ}$ ,  $+10^{\circ}$ ,  $-20^{\circ}$ , and  $-40^{\circ}$  F. ( $27^{\circ}$ ,  $-12^{\circ}$ ,  $-29^{\circ}$ , and  $-40^{\circ}$  C.). In general, as the temperature was decreased the endurance limits of the metals increased. The stress concentration factors showed no consistent change.—S. G.

**\*On the Rôle of Separating Fracture [Trennungsbruch] in the Light of Mohr's Strain Hypothesis.** A. Leon (*Bauingenieur*, 1934, 15, 318-321).—According to general opinion, Mohr's theory is applicable only to shear fracture. For separating fracture, which should be excluded from the theory, experiments have shown that the resistance to separation remains constant irrespective of whether the state of stress is linear, planar, or spatial, which corresponds with the theory of normal principal stress, which, therefore, ought to be utilized to amplify Mohr's theory for the case of separation fracture. Really, however, Mohr's theory covers separation fracture and the phrase constancy of resistance to separation, the shape of the sheath lines (Hüll lines) giving an indication of the circumstances in which separation or shear fracture will occur.—B. Bl.



**\*Impact Torsion Tests (No. 2).** I.—1700 r.p.m. Impact Torsion Tester. II.—Impact and Static Torsion Diagrams of Metals at Room Temperature. III.—Considerations of the Dynamic Sliding Resistance of Metals. Mititosi Ithihara (*Tech. Rep. Tôhoku Imp. Univ.*, 1935, 11, 489-490, 490-504, 505-511; and (in Japanese) *Trans. Soc. Mech. Eng. Japan*, 1935, 1, 20-27). —[In English.] (I.—) The apparatus, in which the twisting moment and angle of twist are recorded photographically, is briefly described with reference to a photograph and diagram. (II.—) The impact and static torsion diagrams of brass, tin, lead, copper, aluminium, zinc, and Duralumin have been constructed and compared with those of various ferrous metals. For face-centred cubic metals the 2 curves are almost coincident, whereas for body-centred cubic metals, e.g. iron, the angle of twist in the impact test is about 10-20% greater than that in the static test and the yield-point is about 3 times as great. (III.—) The dynamic sliding resistance of a metal is shown to consist of the sum of the elastic resistance and the viscous resistance. The shape of the impact diagram of body-centred cubic metals is attributed to the decrease of elastic resistance and coeff. of viscosity when the specific sliding speed is increased owing to increasing atomic disorder. With face-centred cubic metals the sliding planes are of greater symmetry, and hence the static and impact curves are parallel to one another.—A. R. P.

**\*Impact Torsion Tests (No. 3).** I.—Coefficients of Viscosity of Solid Metals. II.—Impact Torsion Tests of Cold-Worked Metals. Mititosi Ithihara (*Tech. Rep. Tôhoku Imp. Univ.*, 1935, 11, 512-516, 516-525; and (in Japanese) *Trans. Soc. Mech. Eng. Japan*, 1935, 1, 27-31).—[In English.] (I.—) The apparent coefficients of viscosity ( $\mu$ ) of metals have been obtained from the difference between the moments in the impact and static torsion tests. At sliding speeds of 1700 r.p.m.  $\mu$  in kg.-sec./cm.<sup>2</sup> has the following values: brass 5.27, aluminium 3.28, zinc 2.55, copper 1.90, lead 0.06, Duralumin 0. The values for steels are much higher. (II.—) The impact diagrams of cold-worked and aged copper and brass show higher yield-points than those of the annealed metals to an extent which depends on the degree of ageing.—A. R. P.

**The Hardness Testing of Light Metals and Alloys.** R. L. Templin (*Amer. Soc. Test. Mat. Preprint*, 1935, 1-15).—One of the most used tests in the commercial inspection of metals is the hardness test, of one form or another. The success attained in applying the hardness tests to ferrous metal products has quite naturally suggested similar uses for non-ferrous products. A critical review of the factors affecting the more common hardness tests, however, reveals effects of different magnitude in some important instances, which would seem to mitigate seriously against the satisfactory use of the hardness tests for many of the light alloys. The presence of the oxide films on aluminium alloys, and the alloys coated with relatively thin layers of other different alloys are examples of the more conspicuous difficulties. The effects of other factors, such as load-penetration-time relationships, anvil or support, size and preparation of specimen, are quantitatively quite different from those for ferrous metals. Likewise the relationships between different kinds of hardness and between hardness and the other static properties of the light alloys are quantitatively different from those obtained in ferrous metals. With these facts in mind the application of the hardness tests to general classes of commercial light-alloy products is discussed.—S. G.

**A New Method and Machine for Dynamic Hardness Testing [Ballentine Hardness Tester].** W. M. Patterson (*Amer. Soc. Test. Mat. Preprint*, 1935, June, 1-10).—P. points out the need for a reliable hardness scale with definite physical units of equal value throughout the scale, and comments briefly on previous work in this field, giving reasons for the inadequacy of past methods. A new machine for dynamic hardness testing is described, and the development of a scale fulfilling the desired conditions is explained. Test data are

given for alloys of lead, copper, and aluminium, cast iron and soft and medium-hard steels. The reproducibility of results to be expected with the method in laboratory and production work is estimated, and a brief discussion is given of the advantages and particular field of use of the machine.—S. G.

**A Method of Hardness Testing of Materials.** Manabu Nakano (*J. Soc. Mech. Eng. Tokyo*, 1933, 36, (193), 322–325).—[In Japanese.]—S. G.

**\*The Thermal Conductivity of Metals in the Form of Small Bars.** Aurel Potop (*Compt. rend.*, 1935, 200, 1733–1735).—The thermal conductivity of small bars can be determined (cf. *Compt. rend.*, 1934, 198, 1847) by the energy dissipated by a small furnace in an enclosed space, when it is traversed by the bar which radiates the heat taken from the furnace. There are 2 difficulties in carrying out this method: (1) the coeff. of thermal exchange between the bar and the furnace is not very well defined; (2) when the bar is rather long (as is necessary for good conductors), it requires very careful centering. These 2 difficulties render void the underlying theory of the method which essentially presumes that the coeff. of exchange of the bar is constant at all points. To obviate these difficulties the furnace was rigidly fixed in the chamber in the correct position, and the diameter of the space in which the bar radiated was slightly increased. P. Vernotte has shown (*J. Physique*, 1933, 4, 7, and *Sci. et Ind.*, 1933, Nos. 228–233) that:  $\frac{\pi DT}{Q} = \frac{1}{H\lambda} + \frac{1}{h(\mu - \lambda)} + \frac{\mu}{Dk} \left( \frac{4}{3} - \eta \right)$ , where  $Q$  is the heat dissipated by a bar of diameter,  $D$ , for a temperature difference,  $T$ , between the furnace and the surrounding space,  $H$  the coeff. of exchange between the furnace and the bar, and  $h$  that between the space and the bar,  $k$  the coeff. of conductivity,  $\mu$  and  $\lambda$  are the lengths of the bar and its seating in the furnace, respectively, and  $\eta$  is a parameter defining the position of the bar. Hence  $Q$  is an inverse linear function of  $\eta$ , and this has been verified experimentally with a bar of silver containing 10% of copper, 4 mm. in diameter and 117 mm. long. The value of  $k$  was found to be 0.82 cal. cm.<sup>-1</sup> deg.<sup>-1</sup> sec.<sup>-1</sup> as opposed to 0.84 found by older methods.—J. H. W.

## XII.—TEMPERATURE MEASUREMENT AND CONTROL

(Continued from pp. 306–307.)

**Indicating Pyrometers.** M. D. Pugh (*Met. Ind. (Lond.)*, 1935, 46, 647–649).—A brief description is given of the use of indicating pyrometers in various metallurgical operations.—J. H. W.

**Triple Range Optical Pyrometer.** — (*Blast Fur. and Steel Plant*, 1935, 23, 280).—A brief note on the Pyro pyrometer with 3 scales: 1400°–2200° F. (760°–1204° C.), 1800°–3400° F. (982°–1871° C.), and 2200°–3700° F. (1204°–2020° C.), the latter corrected for direct reading of true spout and pouring temperatures of molten metal in the open.—R. Gr.

## XIII.—FOUNDRY PRACTICE AND APPLIANCES

(Continued from pp. 307–308.)

**Some Factors which Influence Soundness in Non-Ferrous Castings.** Arthur Logan (*Found. Trade J.*, 1935, 52, 345–348, 367; discussion, 367–368).—Read before the Scottish Branch of the Institute of British Foundrymen. The following are dealt with: present-day practice in casting brasses and bronzes; excessive specifications; causes of unsoundness; percentage waste; defects due to the sand; melting; mould conditions; fluidity; cooling; controllable variables and the density of castings. In the discussion some defects were ascribed to “tired metal.”—J. H. W.

**Eliminating Surface Defects.** R. V. Wallace (*Blast Fur. and Steel Plant*, 1935, 23, 251–252, 278–279).—Considers the defects arising from the method

of construction and use of ingot moulds in steel practice in particular, but the observations are applicable to non-ferrous practice.—R. Gr.

**Difficulties and Their Remedies in the Casting of Thin-Walled Aluminium Caps.** — Rahn (*Giesserei-Praxis*, 1935, 56, 13-14).—The precautions to be observed in making the cores and moulds, and in melting aluminium for thin-walled castings are given.—J. H. W.

**Difficulties in the Manufacture of "Aluminium-Bronze" Castings.** M. Schied (*Giesserei-Praxis*, 1935, 56, 73-76).—The difficulties connected with making "aluminium-bronze" castings containing 90 : 10 copper-aluminium, with or without up to 12% (total) of iron, nickel, manganese, silicon, and tin are described, as to the use of pure material, making up the pre-alloy, the composition of the charge, and mould manufacture.—J. H. W.

**\*Dense Bronze Castings.** G. Somigli (*Industria meccanica*, 1935, 17, 115-125; *C. Abs.*, 1935, 29, 3283).—The various factors which influence the density of a bronze casting were studied experimentally. Moulding methods, shape of mould, composition of alloy, starting material, melting procedure, and temperature of pouring were investigated, and the microstructures compared. The best casting temperature is 1090°-1100° C. The numerous tests are described. A bibliography of 21 references is given.—S. G.

**The Manufacture of Marine Propellers.** L. M. Atkins (*J. Amer. Soc. Naval Eng.*, 1935, 47, 229-240).—The operations used in the manufacture of a high-tensile bronze propeller, including the preparation and assembling of the pattern, the method of moulding, the drying of the mould first for 24 hrs. at 150° C., then for 48 hrs. at 205° C., and finally at 230° C. until dry, the preparation and melting of the metal, the procedure of casting, the cooling for approximately 7 days, and the final machining are dealt with in detail.

—J. W. D.

**Die-Casting of Brass.** John R. Freeman, Jr. (*Metals Technology*, 1935, 2, A.I.M.M.E. Tech. Publ. No. 615, 1-7).—Describes briefly the Pack and Polak die-casting machines, with special reference to their use with brass. Results of tensile and impact tests on brass die-castings are given. When compared with the standard sand-casting alloys, the die-cast brass alloys in general show superior tensile strength, but lower elongation values. Brass die-castings made properly in Pack and Polak machines are practically free from visual internal cavities, but contain microscopic blowholes and shrinkage cavities, and have not the inherent soundness of forged metal.—W. H.-R.

## XV.—FURNACES AND FUELS

(Continued from pp. 308-309.)

†**The Bright-Annealing of Non-Ferrous Metals.** W. Wirt Young (*Gas Age-Record*, 1935, 75, 409-411, 414).—Plant and processes for the bright-annealing of non-ferrous metals by means of gaseous products of town's gas after cracking or after combustion and purification are discussed and illustrated.—J. S. G. T.

**The Bright-Annealing of Metals.** Verdon O. Cutts (*G.E.C. Journal*, 1934, 5, 145-149).—Deals mainly with batch-type bright-annealing furnaces, particular reference being made to the Grünewald furnace, the feature of which is that it can be used for the bright-annealing of ferrous and non-ferrous metals without the use of a special atmosphere.—S. V. W.

**Use of Electric Furnaces in Industrial Heat-Treatment.—III.** A. Glynn Loble (*Metallurgia*, 1935, 12, 9-13).—See *Met. Abs.*, this volume, pp. 114, 180. A review of the advances made in furnaces for bright-annealing and clean-hardening. Bright-annealing furnaces described are bell-type and water-sealed furnaces for batch-annealing, and wire-mesh belt-conveyor, roller-hearth, small semi-continuous, and vertical continuous furnaces for continuous annealing. Consideration is also given to special gases for bright-annealing.

—J. W. D.



**Special Atmospheres in the Heat-Treatment and Brazing of Metals.** C. L. West (*Iron Age*, 1935, 135, (20), 18–22, 86).—The use of “Elfurno” gases, instead of hydrogen or other strongly reducing gases, as an atmosphere in heat-treatment and brazing furnaces is cheaper and provides more flexible control. The “Elfurno” gas atmosphere is produced by simple combustion of carbonaceous gases with suitable quantities of air in a special gas-producer at properly controlled temperatures. When practically all the oxygen from the atmospheric gas is eliminated, excessive amounts of hydrogen and other reducing components are unnecessary, thus reducing the cost of the gas.

—J. H. W.

**The Reactance of Large Rectangular Three-Phase Electric Furnaces.** F. V. Andrae (*Electrochem. Soc. Preprint*, 1935, Mar., 175–191).—Mathematical. Tables and formulæ are given for rapidly determining the reactance of large furnaces and their other characteristics.—A. R. P.

**\*On the Fundamental Equations for the Design of Electric Resistance Furnaces.** Kōichirō Maekawa (*J. Inst. Elect. Eng. Japan*, 1933, (543), 873–881; *Jap. J. Eng. Abs.*, 1935, 13, 34).—[In Japanese, with English abstract]. From careful experiments, M. obtained a practical design formula for electric resistance furnaces as follows:  $y = ax^{0.41}$ ;  $a = 0.0017T^{1.55}$ , where  $y$  is expressed in watts,  $x$  is the volume of the furnace in  $\text{cm}^3$ , and  $T$  is the temperature in  $^{\circ}\text{C}$ . The applicability of this formula was verified in the design of two electric resistance furnaces for industrial purposes.—S. G.

**High-Temperature Insulation for Industrial Furnaces.** N. Allen Humphrey (*Blast Fur. and Steel Plant*, 1934, 22, 703–704, 712; 1935, 23, 85–87, 134–135, 141, 198–199, 212–214, 267–268).—Deals with calculations of fundamentals of high-temperature insulation.—R. Gr.

**Developments in the Electrical Industry During 1934.** John Liston (*Gen. Elect. Rev.*, 1935, 33, 5–62).—In this general review the following are of interest to non-ferrous metallurgists: continuous controlled-atmosphere electric furnace for bright-annealing copper tubing in coils and straight lengths: furnaces for bright-annealing nickel-silver blanks and the continuous hydrogen-brazing of steel assemblies, developments in the use of pressed metal powders, oxygen-free copper, and beryllium alloys.—S. V. W.

## XVI.—REFRACTORIES AND FURNACE MATERIALS

(Continued from p. 309.)

**Refractories in the Foundry.** H. C. Biggs (*Found. Trade J.*, 1935, 52, 351–352, 354).—Read before the Edinburgh Section of the Institute of British Foundrymen. A description is given of the composition and use of fireclays, their service behaviour, spalling slag attack, working conditions, rammed and brick linings, bonding materials, and the different requirements of various portions of the furnace lining.—J. H. W.

**\*A Method for Decreasing the Porosity of Melting Tubes Made of Alumina.** Tomo-o Satō (*Tech. Rep. Tōhoku Imp. Univ.*, 1935, 11, 608–619).—[In English.] The porosity of alumina crucibles for use in the Tammann carbon resistance furnace is decreased by repeatedly soaking them in solutions of aluminium salts and heating between successive soakings to a temperature above the decomposition point of the salt.—A. R. P.

**Characteristics of Some Special Refractory Products.** Marcel Lépling (*Ind. chim. Belge*, 1934, [ii], 5, 393–403, 443–449).—The composition, melting point, resistance to compression, density, and porosity of numerous commercial grades of aluminosilicate bricks are tabulated and briefly discussed.—A. R. P.

**Reduction of the Porosity of Normal Firebricks.** — Beninga (*Tonind. Z.*, 1934, 58, 651–652).—Very dense firebricks are obtained by using less than

8% of binding clay with the grog; provided that the latter is suitably graded, however, a reduction in the clay content is unnecessary.—B. Bl.

**Reduction in the Porosity of Normal Fireclay Bricks.** A. Möser (*Tonind. Z.*, 1935, 58, 779-781, 1260-1262).—A method is described for the manufacture of dense bricks with any desired ratio of grog and clay.—B. Bl.

**The Reduction of Porosity of Normal Fireclay Bricks.** — Beninga (*Tonind. Z.*, 1935, 58, 1047).—A critical contribution to Möser's paper (cf. preceding abstract).—B. Bl.

## XVIII.—WORKING

(Continued from pp. 309-311.)

**Cold-Pressing and Drawing.** — (*Metallurgist* (Suppt. to *Engineer*), 1935, 10, 24-26).—A review of the papers presented at the joint discussion on the subject held by various technical societies in London (and to be published in *Proc. Inst. Automobile Eng.*).—R. G.

**The Effect of Roll Diameter in the Rolling of Sheets.** W. Trinks (*Blast Fur. and Steel Plant*, 1935, 23, 415, 430).—Discusses briefly the relation of roll diameter to the amount of "crown" produced on a sheet. It is stated that, generally, in rolling heavy packs of sheets increase of roll diameter reduces "crown," but in rolling thin packs, increase of roll diameter increases "crown."—R. Gr.

**Maintenance of Roll Neck Bearings.** A. H. Frauenthal (*Blast Fur. and Steel Plant*, 1935, 23, 329, 330, 340-341).—Discusses deflection of roll necks and the design of bearings to cope with this effect.—R. Gr.

**Evolution in Seamless Tube Manufacture.** Gilbert Evans (*Met. Ind. (Lond.)*, 1935, 46, 555-556).—See also *Met. Abs.*, this volume, p. 74. The evolution of seamless tube manufacture from the Mannesmann cross-roll piercing process of 1887 is briefly reviewed.—J. H. W.

**Development in Manufacture of Seamless Tubes.** Gilbert Evans (*Metalurgia*, 1935, 12, 27-28, 34).—See also *Met. Abs.*, this volume, p. 74. The latest American developments in the reduction of diameters and wall-thickness of tubes is discussed. A description is given of the recently-developed Foren rolling-mill process, which is based on the principle of "kneading" the material or subjecting the metal to pressure between solid surfaces at different points. A comparison is made of the output and properties of the product of this process with the Pilger process. The general arrangement of the recently-developed Diescher process, which is used for non-ferrous tube manufacture in the U.S.A. is also given.—J. W. D.

†**Wire-Drawing in Latin Literature from Antiquity to Renaissance.** Wilhelm Theobald (*Glaser's Ann.*, 1934, 115, 57-59).—Historical survey.—B. Bl.

**Spinning Sheet Metals.** W. B. Francis (*Met. Ind. (N.Y.)*, 1935, 33, 155-158).—The principles and modern tools and methods of spinning metals are described.—A. R. P.

## XIX.—CLEANING AND FINISHING

(Continued from pp. 311-312.)

**Recent Advances in Metal Cleaning Technology.** R. W. Mitchell (*Metal Cleaning and Finishing*, 1935, 7, 9-14, 65-68; *C. Abs.*, 1935, 29, 3275).—A brief description of some of the more important recent developments. The physical properties are given of the following recently adopted cleaning solvents:  $\text{o-C}_6\text{H}_4\text{Cl}_2$ , tetrachlorethylene, trichlorethylene, propylene dichloride, ethylene dichloride, and  $\text{CCl}_4$ , and the corrosion of copper, steel, brass, and KA2S in these solvents was measured in mg./in.<sup>2</sup>. Solvents, soaps, and sulphonated cleaners are discussed.—S. G.

**Cleaning Metals for Plating.** D. W. Robinson (*Monthly Rev. Amer. Electroplaters' Soc.*, 1935, 22, (5), 32–36).—Gives some practical hints on cleaning metals in hot alkaline baths and in electric cleaners, together with the compositions of suitable baths for various purposes.—A. R. P.

**Electrochemical Interpretation of Pickling Processes.** E. Jimeno and I. Grifoll (*Anales soc. españ. fis. quim.*, 1934, 32, 1135–1141; *C. Abs.*, 1935, 29, 3240).—A discussion of the reactions involved.—S. G.

**†Metal Colouring with Molybdate Solutions.** H. Krause (*Mitt. Forschungsinst. Edelmetalle*, 1935, 8, 138–143).—Zinc can be coloured various shades of brown to black by immersion in an oxalic acid solution of ammonium molybdate, and tin, lead, and cadmium by immersion in molybdate solutions containing sodium fluoride or silicofluoride. Black tones on zinc and aluminium are obtained in thiosulphate–molybdate baths or in sodium acetate–ammonium molybdate baths. The effects of varying the concentration of the bath and the time of immersion on the colours of the films produced on aluminium and zinc are described, and recent patent literature on the subject is reviewed.

—A. R. P.

**Colouring Aluminium Brown, Black, and Grey.** H. Krause (*Aluminium*, 1935, 17, 259–260).—Aluminium may be coloured brown by pickling in a hot solution containing potassium permanganate 5–10 grm., copper nitrate 5 grm., and nitric acid (*d* 1.35) 2–4 c.c. per litre. A light brown colour is obtained in 5 minutes and a velvet brown in 10–15 minutes; to obtain a black colour the copper nitrate content is raised to 20–25 grm./litre and the time of immersion to 30 minutes. A matt grey colour is obtained with a pickle containing diammonium hydrogen phosphate 100 and manganese nitrate 5 grm./litre.

—A. R. P.

**\*Rapid Electrolytic Patina on Copper.** G. L. Craig and C. E. Irion (*Metals and Alloys*, 1935, 6, 35–37).—When a clean copper sheet is made the anode in a solution of sodium carbonate or, preferably, bicarbonate (e.g. an 8% solution) and a current of 15 amp./dm.<sup>2</sup> is passed from it to an iron cathode, a beautiful green patina is formed in 1 minute. The coating consists essentially of a basic carbonate (malachite), is very adherent, and does not flake on bending or by temperature changes between +50° and –23° C.; on prolonged exposure to the atmosphere it is converted into the basic sulphate, brochantite, without change of colour or structure, the atmospheric sulphur trioxide simply replacing the carbon dioxide. The patina may be produced *in situ* on old or new structures provided any oxide is first removed by a sulphuric acid wash, followed by a water spray; an iron roller covered with a felt pad impregnated with the solution is then passed over the copper while the correct current is passed between the two.—A. R. P.

**Lacquering Metallic Articles.** Erik Hallström (*Industritidning. Norden*, 1934, 62, 188–189).—A review.—S. G.

**\*Finishing and Frictional Resistance of Bearing Metal (A New Apparatus Devised for Finishing the Metal Surface).** Motomu Ishida (*Bull. Research Office Jap. Govt. Railways, Tokyo*, 1933, 21, (25), 1–47; *Jap. J. Eng. Abs.*, 1935, 13, 13).—[In Japanese.] I. gives some details of the finished surface of bearing metals and their practical value as determined by friction tests on the surfaces of the metals finished by various methods, and from measurements of their frictional resistance and increase in temperature. Further, he proposes the use of a new finishing device for obtaining the best surface for bearing metals.

—S. G.

**\*A Study on the Manufacture of Tools. II.—Investigation on the Abrasive Action of Grinding Wheels.** Yaekiti Sekiguti and Iitro Hasegawa (*J. Soc. Mech. Eng. Tokyo*, 1933, 36, (198), 700–710).—[In Japanese.]—S. G.

**Grinding and Polishing of Aluminium and Its Alloys.** [A.] von Zeerleder (*Aluminium*, 1935, 17, 245–251).—Apparatus for grinding and polishing alu-



minium and its alloys is described, and recipes are given for suitable polishing media. A table showing the mechanical properties of numerous commercial light alloys in various stages of heat-treatment, and many photographs of aluminium alloy surfaces after various polishing processes are included.

—A. R. P.

**Buffing of Electrodeposits of Cadmium.** F. Schwarz (*Oberflächentechnik*, 1935, 12, 82).—The usual cadmium deposits on steel are so soft that even buffing with Vienna lime will produce perforations. It is recommended to harden the deposit by adding zinc to the bath so as to deposit an alloy of 85% cadmium and 15% zinc. This alloy is deposited at a current density of 20–40 amp./ft.<sup>2</sup> from a bath containing equal quantities of zinc and cadmium; it can be buffed with a paste of Vienna lime 12, tallow 2, stearin 2, Montan wax 1, and mineral oil 1 part.—A. R. P.

## XX.—JOINING

(Continued from pp. 312–314.)

**New Metal to Glass Seal.** — (*Amer. Metal Market*, 1934, 40, (185), 7, 10).—A brief note. Tight and reliable joints can be made between glass and the alloy Fernico and may be used in vacuum tubes and parts when gas-tight insulating seals are required. Fernico can be machined, forged, punched, drawn, stamped, soldered, copper-brazed, and welded. Its composition is not given.—I. M.

**Hard Soldering with the Blowpipe.** — (*Oxy-Acetylene Tips*, 1935, 14, 61–62).—The properties of silver solders are described, and recommendations for their application by the oxy-acetylene blowpipe are given—clean, close joints, borax flux, and a soft flame applied to the work only and never to the wire or the solder in the joint. Large copper process vessels with silver-soldered joints are illustrated.—H. W. G. H.

**Special Atmospheres in the Heat-Treatment and Brazing of Metals.** (West.)—See p. 362.

**\*On the Problem of Welding Aluminium.** Stephan Haarich (*Z.V.d.I.*, 1935, 79, 495–499).—The results of comparative tests on the effect of different methods of welding aluminium on its gas content, structure, mechanical properties, and resistance to corrosion are described. Electrical welding methods are satisfactory. The gas content of the weld metal is greater than that of the basis metal in all processes. The hardness, tensile strength, and yield-point all decrease, while the elongation increases with increase in size of the welding flame. Hammering of the weld decreases its resistance to corrosion.

—K. S.

**Repairing Faulty Aluminium Castings.** Edmund R. Thews (*Giesserei-Praxis*, 1935, 56, 119–121).—The precautions to be observed in repairing aluminium castings by welding are given. Particular care must be taken to clean carefully and to preheat the parts to be welded, and to allow them to cool slowly. The process of welding aluminium is described in some detail.

—J. H. W.

**Aluminium Alloy Crankcases.** — (*Soudeur-Coupeur*, 1935, 14, (3), 16–20).—Recommendations are given for repairing broken crank-cases by oxy-acetylene welding, and typical repairs are illustrated, with particulars of welding times and gas consumptions.—H. W. G. H.

**Some Fundamentals of Spot-Welding, Especially of the Light Alloys.** R. H. Hobrock (*Metals and Alloys*, 1935, 6, 19–25, 41–45, 67–69; and (summary) *Light Metals Rev.*, 1935, 1, 403–407).—In spot-welding, union of the parts in contact occurs chiefly by recrystallization of the metal just below the melting point. Although a small amount of local melting usually

occurs, care should be taken to avoid this spreading, otherwise a hole is liable to be formed, especially in thin sheets, owing to the action of the electrical forces on the molten metal. In metal which is to be age-hardened, melting should be avoided since it develops a local "casting" structure which is unsatisfactory for subsequent heat-treatment. The pressure between the electrodes of the welding machine is usually sufficient to break down the surface oxide film without cold-working the metal and, when the current is sufficiently great, to cause the desired recrystallization. Nevertheless, better welds are obtained with highly polished surfaces as these have a lower resistance, and thus local burning is more easily avoided. The best type of electrode is that which gives even distribution of stress, *i.e.* that which terminates in a cone the angle of generation of which is equal to the angle of friction (about  $7^\circ$ ).—A. R. P.

**The Process of Electric Spot-Welding: Its Application to Stainless Steels and Light Alloys.** G. Mandran (*Aciers spéciaux*, 1934, 9, 636-680).—In Part I (19 pp.), the general principles and chief applications of electric spot-welding, and the machines used in the process are described; in Part II (20 pp.) the application of this process to the welding of 18:8 stainless steel is explained; while in Part III (6 pp.) the applications of the process to the spot-welding of aluminium and light alloys (such as Duralumin) are explained.—J. H. W.

**\*Welding of Staybolts in the Coper Firebox Walls of Locomotive Boilers.** —Cramer (*Glaser's Ann.*, 1934, 115, 89-90).—After an investigation of the causes of ring-shaped corrosion areas around the heads of the staybolts, a method is described for welding these bolts into the walls of the boxes so as to avoid unsound places between them and to obtain a smooth firebox wall.  
—B. Bl.

**The Welding of Joints in Copper Pipes for Water and Sanitary Installations.** W. L. Kilburn and E. B. Partington (*Welding Ind.*, 1935, 3, 96-100; discussion, 158-160; and (abstract) *Welding J.*, 1935, 32, 102).—The advantages of copper in plumbers' work, and of bronze-welding as a method of jointing, are explained. Typical joints are illustrated and the technique required to make them is described. It is stated that no trouble need be feared from electrolytic corrosion. When welding copper to brass fittings, it is pointed out, an oxidizing flame should be used.—H. W. G. H.

**Bronze Joints for Copper.** —(*Oxy-Acetylene Tips*, 1935, 14, 53-55).—The fabrication of process piping for a paper mill by bronze-welding is described. It is stated that a bronze-welded joint is not attacked by sulphurous acid or sulphur dioxide any more readily than copper, and that the electrolytic effect produced by two dissimilar metals in mechanical contact is practically absent when they are fused together.—H. W. G. H.

**Lead Welding.** —Korta (*Anz. Masch.*, 1935, 57, (42), 4-5).—Lead is best welded with the oxy-hydrogen flame. Although the acetylene, coal-gas, and petrol blow-lamp flames can also be used, their use is scientifically unsound. A new type of welding torch is described, and the shape of the individual welds is discussed in detail.—B. Bl.

**Lead-Welding with the Oxy-Acetylene Flame.** F. Schulze and Johs. Staebler (*Autogene Metallbearbeitung*, 1935, 28, 68-70).—The use of a small oxy-acetylene blowpipe is recommended instead of the older oxy-hydrogen burners. This should preferably be of the high-pressure type, as flame control is important. Welders, unaccustomed to working with lead, are apt to have difficulty at first on account of its low melting point, but there are no real difficulties in technique.—H. W. G. H.

**\*On a Change of Method of Welding-On Hard Alloys on to Drills.** G. Varshavski (*Azerbaidjanskoe Neftianoe Khozastvo* (Oil Economy of Azerbaidjan), 1934, 14, (1), 81-83).—[In Russian.] Tests of oil-boring drills with welded-on alloys—the harder Pobedit along the edge and for  $\frac{1}{3}$  from the periphery and

the softer Wokar for  $\frac{2}{3}$  from centre to periphery—showed that wear takes place almost entirely along the horizontal plane.—D. N. S.

**\*Laboratory Experiments of Welding-On Hard Alloys by Alternating Current.** P. M. Rostomian (*Azerbaidjanskoe Neftianoe Khoziastvo (Oil Economy of Azerbaidjan)*, 1934, **14**, (9), 47-54).—[In Russian.] Increasing the current in the welding of Wokar (hard alloy) on to boring drills decreases the resistance to wear. The ratios of resistance and homogeneity of welding obtained with d.c. to those with a.c. are: resistance to wear, 1:1, 0.75:1; homogeneity, 1:1.87, 1:2.33; current, 100, 200 amp., respectively.—D. N. S.

**\*Testing Various Methods of Welding-On "Wokar" Alloy.** N. A. Vartanessov and E. V. Chernysheva (*Azerbaidjanskoe Neftianoe Khoziastvo (Oil Economy of Azerbaidjan)*, 1934, **14**, (10), 52-54).—[In Russian.] "Fish-tail" shaped oil-boring drills were tested, in ordinary working conditions, with Wokar hard alloy welded-on by the following methods: (1) ordinary welding-on in 3 layers by a.c.; (2) the same with d.c.; (3) welding-on in strips; (4) the same, but with strengthening of the edges with Pobedit hard alloy; (5) bi-lateral welding-on. Strip welding proved unsatisfactory, and the bi-lateral method has no advantages over methods (1) and (2) while using more hard alloy.—D. N. S.

**Repairing Zinc-Base Die-Castings by Oxy-Acetylene Welding.** C. W. Mace (*Welding Ind.*, 1935, **3**, 79-84; and *Met. Ind. (Lond.)*, 1935, **46**, 477-479, 528-529).—The welding rod should be of similar composition to the casting with slight excess of zinc. The joint should be veed for thicknesses of  $\frac{3}{16}$  in. or over and carefully cleaned, any electroplating being removed from the vicinity. The flame must be adjusted to have a slight excess of oxygen whilst remaining "soft." Puddling of the rod into the molten casting is essential. The remainder of the technique is very similar to that used for aluminium alloy castings. Welds of 100% strength should be obtained.

—H. W. G. H.

**Welding as Applied to Vehicular Structures.** Stanley E. Evans (*Welding J.*, 1935, **32**, 106-108, 123).—Design for economizing in weight is discussed and brief notes on the welding of mild and alloy steels, copper, aluminium, and its alloys are given.—H. W. G. H.

**Application of Electric Welding in Locomotive and Car Repair Shops.** Kaniti Yamaguti (*J. Soc. Mech. Eng. Tokyo*, 1933, **36**, (195), 472-476; *Jap. J. Eng. Abs.*, 1935, **13**, 9).—[In Japanese.] Recent electric welding operations at the Oi Locomotive and Car Repair Shop, and electric welding in general, are described.—S. G.

**Recent Developments Regarding Welded Joints and the Effects of Fatigue.** O. Bondy (*Welding Ind.*, 1935, **3**, 60-64; discussion, 101-104; and (abstract) *Welding J.*, **32**, 70-71).—The present point of view in Germany regarding the fatigue testing of welded joints and their use in fatigue conditions is reviewed.

—H. W. G. H.

**Shrinkage Strains and Stresses Caused by Welding.** Riddervold Jensen (*Welding Eng.*, 1935, **20**, (2), 30-36; (3), 21-23).—Ten rules for minimizing shrinkage stresses and strains are enunciated and enlarged upon. The dangers of residual stress and shrinkage cracks are discussed.—H. W. G. H.

**Some Explosion Experiments with Liquid Acetylene.** Alwin Krausz (*Autogene Metallbearbeitung*, 1935, **28**, 72-74).—It was found that liquid acetylene resisted attempts at ignition by an incandescent wire when the gaseous phase was explosive under the same conditions of temperature and pressure.

—H. W. G. H.