

METALLURGICAL ABSTRACTS

(GENERAL AND NON-FERROUS)

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Part 9

I.—PROPERTIES OF METALS

(Continued from pp. 377-380.)

The Mass of Be⁹ and the Atomic Weight of Beryllium. K. T. Bainbridge (*Phys. Rev.*, 1933, [ii], 43, 367-368).—A letter to the Editor. The mass of Be⁹ determined spectroscopically is 9.0155 ± 0.0006 . If allowance is made for 1 part in 2000 of Be⁸ the atomic weight of beryllium is 9.0130 ± 0.0007 . The packing fraction of Be⁹ is +17.2.—S. G.

***On the Evaporation, Solubility, and Oxidation of Metallic Mercury.** Alfred Stock (*Z. anorg. Chem.*, 1934, 217, 241-253).—The amount of mercury which can be taken up by water, aqueous solutions, and air under various conditions has been quantitatively determined. Mercury is appreciably absorbed by blood. The solubility in benzene, white of egg, filter paper, cotton, linen, silk, rayon, and woollen fabrics, and beetroot discs has been measured as well as the absorptive capacity for mercury vapour from air by water, benzene, paraffin oil, glycerin, carbon bisulphide, sulphur monochloride, phenyl mustard oil, milk of sulphur, flowers of sulphur, phosphorus sulphide, silica gel, activated charcoal, and activated carbon impregnated with iodine. Quantitative adsorption was obtained very rapidly with the last-named. Some observations on the volatility of very small mercury globules are included.—B. Bl.

***The Oxidation and Intercrystalline Brittleness of Nickel.** N. W. Ageev (*Trudi Instituta Metallow (Trans. Inst. Metals, U.S.S.R.)*, 1930, (7), 61-79; *C. Abs.*, 1931, 25, 2960).—[In Russian.] Two grades of commercial nickel showed that nickel is brittle after having been annealed under atmospheric conditions at 800° and 1000° C. Intercrystalline oxidation is the cause of this brittleness.—S. G.

***Positive and Negative Thermionic Emission from Columbium [Niobium].** H. B. Wahlin and L. O. Sordahl (*Phys. Rev.*, 1934, [ii], 45, 886-889).—The electronic and positive ion emission from thoroughly outgassed niobium have been investigated, and the effect of impurities studied. The work-function for the electrons is 3.96 v. with the Richardson constant A equal to 57 amp./cm.²/degree². For the positive ions the work-function is 5.52 v.—W. H.-R.

***On the Mobility of Polonium on and in Silver.** Karl Schwarz (*Z. physikal. Chem.*, 1934, [A], 168, 241-247).—Volatilization of polonium deposited on silver takes place with measurable velocity only above 350°-400° C.; diffusion within the outer silver layers is appreciable at 300° C. and increases with increase in temperature, although no penetration into the body of the silver is detectable below 500° C. The apparent low-temperature volatilization of polonium is explained as follows: the explosive disintegration of one atom tears off another not yet disintegrated atom from the layer, and this atom is then deposited on another part of the apparatus; this action is independent of the temperature between 100° and 350° C.—B. Bl.

***Action of Water on Selenium and Tellurium.** E. Montignie (*Bull. Soc. chim. France*, 1934, [v], 1, 507-508).—Grey selenium is unattacked by water even at 160° C. under pressure, but red selenium dissolves slowly at 50° C. and more rapidly at higher temperatures. Tellurium in all its forms dissolves slowly in water at all temperatures giving tellurium dioxide; heat and pressure accelerate the dissolution.—A. R. P.

* Denotes a paper describing the results of original research.

† Denotes a first-class critical review.

***Bactericidal Effect of Metallic Silver; Antiseptic Action According to Vincent; Oligodynamic Action According to Naegeli.** P. Lasseur *et al.* (*Trav. Lab. Microbiol. Fac. Pharm. Nancy*, 1932, (5), 13; *Zentr. ges. Hyg.*, 1933, 29, 88; (*U.S.*) *Public Health Eng. Abs.*, 1934, 14).—A full discussion of earlier work on the bactericidal effect of metallic silver, with accounts of some experiments using *B. coli* and 3 colour-forming bacteria more sensitive to the action of silver than *B. coli*. Gentle heating of silver wire increased but strong heating decreased the bactericidal action. Increasing the surface area increased the action. Short times of contact decreased the bacterial content but complete destruction of bacteria was not achieved in 24 hrs.—S. G.

***Colour in Films of Sputtered Tin.** Clarence J. Overbeck (*J. Opt. Soc. Amer.*, 1933, 23, 109–113).—Films of tin sputtered from circular cathodes in air showed under monochromatic light rings and cycles of colour, probably due to thickness and interference effects. Films produced in nitrogen were brown and opaque. These were found to consist of a tin-nitrogen compound. Heating the nitride film in air produced a transparent film similar to those sputtered in air.—R. G.

***The Rate of Crystallization of and the Number of Nuclei in Tin, Bismuth, and Lead.** G. Tammann and H. J. Rocha (*Z. anorg. Chem.*, 1934, 216, 17–25).—The rate of crystallization of under-cooled melts is determined by inoculating such a melt in a U-tube in one limb and observing the time taken for the crystallites to reach the meniscus in the other limb or the time taken for a thermocouple in the other limb to show an increase in temperature. A third method consists in determining the grain-size after inoculating the molten metal in a cylindrical container and quenching after the single crystal has reached a certain size, so that the still liquid portion freezes to a finely crystalline aggregate; from the length of the single crystal and the time between inoculation and quenching the rate of crystallization can be deduced. The rate of crystallization of tin, bismuth, and lead has been determined for various degrees of under-cooling by the second and third methods, and from the grain-size of quenched under-cooled melts the number of nuclei present and the influence of the cross-section of the melting tube have been determined.—B. Bl.

***Some Thermionic Properties of Barium Films Adsorbed on Tungsten.** Herbert Nelson (*Physics*, 1931, 1, 84–93).—A full report of work previously noted in abstract. See *J. Inst. Metals*, 1931, 47, 326.—S. G.

***The Effect of Alkali Ions on the Photoelectric Emissivity of Tungsten.** A. Keith Brewer (*Phys. Rev.*, 1933, [ii], 44, 1016–1019).—Known quantities of Na^+ , K^+ , Rb^+ , and Cs^+ ions were deposited on tungsten and the changes in the photoelectric current measured. For wave-lengths below 2800 Å. the current increases proportionally to the fraction f of the surface covered as long as f is small. The emissivity for longer wave-lengths is low at first, and then increases sharply beyond some critical value of f , which increases with the wave-length. The results indicate that the work-function is not uniform over these composite surfaces; this makes it important to fix a definite threshold for the various values of f . The emissivity increases with temperature to about 500° C., where fatigue becomes appreciable. As the filament fatigues for photoelectric emission the positive ion emissivity increases reaching a maximum when the threshold returns to that for clean tungsten. The results show that the alkali dissolves so rapidly in the tungsten that the dependence of the work-function on f cannot be determined at temperatures above 500° C.—S. G.

***Photoelectric Properties of Thin Films of Alkali Metals.** S. Asao (*Physics*, 1932, 2, 12–20).—Measurements are reported on the colour sensitiveness of various photoelectric tubes having cathodes made of alkali metals. A composite surface of R–Ag–RO–Ag of any alkali metal R shows a higher sensitivity over a wider range of wave-lengths than R–RO–Ag and has 2 peaks, one between 330 and 370 μ and one at about 500 μ for potassium and 550 μ .

for rubidium and between 700 and 800 $m\mu$ for caesium. If a gas-filled lamp at 2700° K. is used as a light source, photoelectric currents from vacuum phototubes are obtained sometimes as large as 29 μ a per lumen for potassium, and 10–15 μ a per lumen for rubidium, and 40–50 μ a per lumen for caesium.—S. G.

***Elasticity of Flexure.** A. Jaquero and H. Mügeli (*Helv. Phys. Acta*, 1931, 4, 3–30; *Sci. Abs.*, 1931, [A], 34, 454).—[In French.] As in a previous publication (*ibid.*, 1929, 2, 419–444) only the data referring to the variation of the first modulus of elasticity with temperature are now published, and this for the following materials: iron, copper, gold, silver, platinum, nickel, silica, and glass. The temperature range was 0° to 140° C. and the temperature-elasticity curves, which are given for each material, are found to be similar to that of steel, *i.e.* parabolic. Silica glass proved to be an exception, since it possessed a positive thermoelastic coeff. and almost a linear variation. Thermal and mechanical treatment generally produces an increase of Young's modulus: iron and silica glass exceptionally showing a diminution. Hooke's law is never completely obeyed even for small deformations. Nickel exhibits interesting phenomena.—S. G.

***The Determination of the Character of Viscous Extension of Metals at High Temperatures.** G. Ranque and P. Henry (*Compt. rend.*, 1931, 193, 1061–1063).—See *J. Inst. Metals*, 1932, 50, 149.—S. G.

***The Plastico-Viscous Deformation of Right Circular Cylinders of Soft Metal under Variable Load Axially Directed.** W. E. Grimshaw (*Phil. Trans. Roy. Soc.*, 1934, [A], 233, 217–245).—Subject to the restriction customarily imposed of an order of strain smallness when stress-strain relationships are being considered, an analysis is developed for the motion of a soft-metal cylinder when subjected to a crushing load directed axially, surface friction being regarded as absent. The metal is considered to be homogeneous, isotropic, and incompressible, and coefficients of plasticity and viscosity are used in the stress-strain relationships. The modifying influence of rate of application of load is examined. Theorems of the analysis are shown to be in accord with conclusions reached from experiments especially from those on the compression of copper cylinders (*Res. Dept. Woolwich, R.D. Report*, No. 64, 1927; London: H.M. Stationery Office).—W. H.-R.

***Mechanism of Plasticity.** N. J. Seljakov (*Z. Krist.*, 1932, 83, 426–447; *Sci. Abs.*, 1933, [A], 36, 111).—Cf. *J. Inst. Metals*, 1932, 50, 597. For rock salt, plastic deformation is accompanied by the appearance of intermediate layers of monoclinic symmetry. The change of symmetry is brought about by simple gliding. The different values of the characteristic angle α for the monoclinic layers produces "starring" on the X-ray photographs.—S. G.

Plasticity and Hardening. O. Manfred (*Z. physikal. Chem.*, 1932, [B], 15, 383–387; *Sci. Abs.*, 1932, [A], 35, 466).—Evidence is presented to show that plastic distortion of a material is always followed by increase of hardness, whether the material is polycrystalline like a metal or a plastic colloid like rubber. This parallel relation, which seems to be independent of the ultimate structure of the material, may be regarded as a new general principle.—S. G.

The Relation Between Plastic Shortening and Pressure in Compression of Salts and Metals. Karl Przibram (*Sitzber. Akad. Wiss. Wien, Math.-naturw. Klasse*, 1933, Abt. IIa, 142, 377–380; *C. Abs.*, 1934, 28, 3633).—The decrease in height of either a metal (lead, copper) or an alkali halide salt crystal with pressure is proportional to the product of the pressure and the width. The plasticity coeff., b , of the alkali halide salts depends on the atomic number of the anion and of the cation. Plotting atomic number of anion against b gives a straight line.—S. G.

Reactions in Solids. Roland Ward (*Trans. Illinois State Acad. Sci.*, 1933, 25, 167–169; *C. Abs.*, 1934, 28, 3634).—A review of the work of van Liempt, Langmuir, Hume and Colvin, Tammann, Hedvall, Sander, and others. Re-

action is initiated by deformation of the crystals through grinding, followed by rearrangements to form more stable products. Higher temperatures increase the diffusion velocities at the crystal interfaces.—S. G.

***Superficial Oxidation of Molten Metals.** R. Delavault (*Bull. Soc. chim. France*, 1934, [v], 1, 419-424).—Tests made on the oxidation of molten metals in air have confirmed the theory of Pilling and Bedworth (*J. Inst. Metals*, 1923, 29, 529) that oxidation occurs only when $Wd/wD > 1$, where W is the molecular weight of the oxide, D its density, d the density of the metal, and w the weight of metal in a gramme-molecule of oxide. For magnesium-aluminium alloys at least 40% of aluminium is required to prevent oxidation in air. For melting magnesium, ammonium borofluoride with or without borax affords adequate protection.—A. R. P.

***On Experiments on Hot-Pressing of Highly Dispersed Metal Powders.—III.** W. Trzebiatowski (*Z. physikal. Chem.*, 1934, [A], 169, 91-102).—Cf. *ibid.*, 1934, [B], 24, 75, 87. Chemically prepared copper and gold powders were pressed to solid crystalline bodies at 20°-600° C. under 15,000 atm. The density and hardness of the bodies increased up to 200° C. to very high values, and X-ray examination showed strain-hardening. Between 200° and 400° C. the density still further increased, but the hardness decreased, although no grain-growth occurred, the changes being explained as crystal recovery. The maximum density obtained was that of the massive metal, but the hardness at this point was much greater. The specific electrical resistance, and its temperature coeff. corresponded with those of the massive metals. At pressing temperatures of 450°-600° C. the hardness decreased and recrystallization occurred.—B. Bl.

***Ignition Temperatures [of Metals] as a Function of Particle Size.** G. Tammann and W. Boehme (*Z. anorg. Chem.*, 1934, 217, 225-236).—If small strips or wires of metal are allowed to slide through a laboratory tube furnace a relation can be found between the ignition temperature (t) and the cross-sectional area of the strip (q). For $q = 0.02-0.4$ mm.², t is given by the following equations: electrolytic iron in air, angular strip, $1015-t = 4.80/q$; electrolytic iron wire, in air, $1128-t = 3.50/q$; electrolytic iron wire in oxygen, $1000-t = 5.80/q$; manganese in air, $1225-t = 15.5/q$; magnesium in air, $630-t = 0.10/q$; cerium in air, $550-t = 2.25/q$. If the iron wire is coated with silver it does not ignite below the melting point of the coating. If the boiling point of the metal is much above the melting point of its oxide, ignition occurs only when the oxide film shrinks or melts. In metals, the vapour pressure of which is appreciable at the ignition temperature but the oxides of which melt much above this point (e.g. magnesium), oxidation of the vapour in air is accompanied by the development of smoke. Solid solutions of gold in iron have the same value for t as electrolytic iron, but additions of nickel, silicon, and aluminium tend to increase t for iron. The particles of steel rubbed off by a carborundum disc are partly angular fragments of iron and partly molten spheres of oxide with a diameter of 0.05-0.24 mm. the average value being 0.1 mm. Corresponding figures are given for some steels. The ignition temperatures of the following pyrophoric metals have been determined: iron (reduced in hydrogen at 370° C.) - 11° C. in air, - 15° C. in oxygen; cobalt (reduced in hydrogen at 320° C.) 3° C. in air; nickel (treated in hydrogen at 350° C.) - 6° C. in air, - 9° C. in oxygen; osmium powder (reduced in hydrogen at 200° C.) about 500° C. in air.—B. Bl.

***The Optical Properties of Metallic and Crystalline Powders.** A. H. Pfund (*J. Opt. Soc. Amer.*, 1933, 23, 375-378).—The procedure developed for the production of very finely-divided bismuth (bismuth black) has been found applicable to a wide variety of metals, including gold, silver, nickel, copper, zinc, and lead. The method consists in the distillation of the metals at high pressure. Measurements of the transparency of the blacks in the infra-red are given.—R. G.

***The Isotopic Constitution and Atomic Weights of the Rare-Earth Elements.** F. W. Aston (*Proc. Roy. Soc.*, 1934, [A], 146, 46-55).—A provisional survey is given of the isotopic constitutions of all the rare-earth elements. More than 30 new isotopes have been discovered. Estimates of the percentage abundance of each isotope are given and the chemical atomic weights are calculated therefrom. The following values of atomic weight are so derived: lanthanum, 138.91 ± 0.05 ; cerium, 140.13 ± 0.05 ; praseodymium, 140.91 ± 0.05 ; neodymium, 143.5 ± 0.2 ; samarium, 150.1 ± 0.2 ; europium, 151.90 ± 0.03 ; gadolinium, 156.9 ± 0.2 ; terbium, 158.91 ± 0.05 ; dysprosium, 162.5 ± 0.2 ; holmium, 164.91 ± 0.05 ; erbium, 167.15 ± 0.2 ; thulium, 168.91 ± 0.05 ; ytterbium, 173.2 ± 0.2 ; lutecium, 174.91 ± 0.05 . Revision of the international atomic weights is desirable in the case of neodymium, samarium, gadolinium, terbium, thulium, and particularly holmium and erbium.—J. T.

***On the Theory of Electrolytic Transmission and Diffusion in Crystals.**—II. W. Jost (*Z. physikal. Chem.*, 1934, [A], 169, 129-134).—Mathematical. Cf. Part I, *J. Chem. Physics*, 1933, 1, 466.—B. Bl.

The Thermionic Work-Function and the Slope and Intercept of Richardson Plots. J. A. Becker and W. H. Brattain (*Phys. Rev.*, 1934, [ii], 45, 694-705).—

(1) The thermionic emission current (i) from a metal can be represented by the Richardson equation $i = AT^2 e^{-b/T}$, where T is the absolute temperature, and A and b are constants. This implies that if $\log i - 2 \log T$ is plotted against $\frac{1}{T}$, a straight line is obtained of which the slope is $b/2.3$, and the intercept $\log A$.

The slope of this line which is sometimes really slightly curved is sometimes called the work-function. (2) Fermi-Dirac statistical theory gives the equation $\log i - 2 \log T = \log U(1-v) - w/2.3T$, where U is a universal constant of value 120 amp./cm.² °K², v is the reflection coeff., and w is the theoretical work-function. Consequently A and b in (1) can be identified with U and w in (2) only, if $r = 0$ and w is independent of temperature. The authors show from experimental and theoretical considerations that r is negligibly small, but that in general w varies with temperature, which is to be expected from the Sommerfeld theory, since w depends on the number of free electrons per unit volume, and this varies on account of expansion. Hence A in the empirical equation is not a universal constant. (3) In the thermodynamic theory the so-called heat-function h is defined as $h = \lambda_p/R - 5/2T$, where λ_p is the latent heat of vaporization of electrons per gm.-mol. The authors show that h can be identified with b , and that $h = w - Tdw/dT$. (4) The photoelectric work-function is equal to w , and is consequently not really independent of T , as has sometimes been assumed. The paper is a useful correlation of experiment and theory where confusion has been caused by using the same term with different meanings.—W. H.-R.

Directions of Discontinuous Changes of Magnetization in a Rotating Monocrystal of Silicon Iron [Barkhausen Effect]. L. W. McKeehan (*Phys. Rev.*, 1934, [ii], 45, 839-840).—A note. In a single crystal of 3% silicon iron, slowly rotated in a magnetic field, almost all of the large Barkhausen changes can be explained as due to simple reversals along one of the directions of easy magnetization here of the form $<100>$.—W. H.-R.

On the Hypothesis of a Critical Field in Superconductivity. David Rittenhouse Inglis (*J. Franklin Inst.*, 1924, 217, 227-228).—A brief discussion.—S. G.

II.—PROPERTIES OF ALLOYS

(Continued from pp. 380-383.)

*A Study of the Aluminium-Rich Aluminium-Copper-Silicon Alloys.—III. Chiuyō Hisatsune (*Suiyō-Kwaishi*, 1929, 6, (1), 31-34; (2), 199-211; *Japanese J. Eng. Abs.*, 1933, (9), 69).—[In Japanese.] Cf. *J. Inst. Metals*, 1933, 53, 294. Alloys containing copper up to 40% and silicon up to 8% were prepared, quenched at 450°-520° C. and aged at 100°-200° C. The ageing phenomena were observed. The changes of tensile strength and Charpy impact value of wrought and cast alloys due to quenching and artificial ageing were studied, and also the impact hardness at 25°-500° C. The quenched and aged alloys showed the highest values. It was found that 450°-500° C. was the best temperature for forging and that the alloys containing more than 4% silicon and more than 6% copper were unsuitable for this purpose. The mechanical and physical properties are considerably improved by heat-treatment. The alloy containing copper 4 and silicon 2-4% is superior in many respects to the other aluminium-rich aluminium-copper-silicon alloys. —S. G.

*A Study of the Aluminium-Rich Aluminium-Copper-Silicon Alloys. Chūyō Hisatsune (*Suiyō-Kwaishi*, 1930, 6, (4), 373-379; *Japanese J. Eng. Abs.*, 1934, (10), 48).—[In Japanese.] H. investigated the time required for the dissolution and diffusion of the soluble constituents in the solid solution by measurements of Rockwell hardness and electrical resistance, and by microscopic examination. He also studied the artificial ageing of these alloys; 5 hrs. were found to be sufficient to heat the specimens at 500° C. for the purpose of the so-called solution treatment.—S. G.

Silumin-Gamma, the New Quality Alloy for Heat-Treatment. J. Dornauf (*Aluminio*, 1934, 3, 68-73).—A small addition of magnesium to Silumin renders it susceptible to great improvements by heat-treatment. The changes in structure and properties produced by various heat-treatments are illustrated.—G. G.

A New Aluminium Light Alloy "Chlumin." Ichirō Iitaka (*Zassan (J. Japanese Soc. Naval Arch.)*, 1931, 48, 165-177).—[In Japanese.] See *J. Inst. Metals*, 1932, 50, 11, 221, 425, 661.—S. G.

*Elastic Hysteresis of Aluminium and Its Alloys. G. Colonnati and G. M. Pugno (*Atti Pont. Accad. Sci. Nuovo Lincei*, 1930, 14, 435-488; *Sci. Abs.*, 1931, [A], 34, 264).—The elastic properties of the alloys of aluminium do not depend only on the chemical composition of the alloy but also, and perhaps more, on the thermal and mechanical treatment that the material has undergone. The following 3 properties which were noted in alloys of copper were found also in aluminium alloys. (1) The irreversibility of the phenomenon of deformation. If a specimen is gradually subjected to a load increasing from zero to an arbitrary value and the load is then gradually decreased the deformations observed on the original process are in general different from those in the reverse process. (2) The adjustment of the cycles. If the operation of loading and unloading is repeated a second time the deformation curve is different in the latter case from that in the first. (3) The modulus of elasticity assumes for each material a value practically constant immediately after every inversion of the sense of variation of the load. In some respects the characteristics of the alloys of aluminium differ from those of copper. Whilst in the case of the copper alloys examined the modulus of elasticity always assumed after every regression a maximum value, with numerous specimens of aluminium alloys the characteristic value of the modulus immediately after a regression was a minimum. Attention is directed to the asymmetry of the bilateral cycles, that is, the diversity of the values

that, other circumstances being equal, the modulus of elasticity can assume according as the experiment is with tension or compression.—S. G.

***The Influence of Temperature on the Elastic Properties of Cast Aluminium Alloys.** M. v. Schwarz and A. Evers (*Z. Metallkunde*, 1934, 26, 37-39).—Comparative tensile tests on a self-hardening American alloy and on a German alloy showed the former to have the better mechanical properties at high temperatures (up to 250° C.). The Brinell hardness of the specimens was also determined three days after the tensile test. The original must be consulted for details of the results.—B. Bl.

***On the Problem of the Electromotive Force and Electrical Conductivity of Alloys of Antimony and Cadmium.** B. N. Volfson and V. N. Rojdestvenskiy (*Zhurnal eksperimental'noy i teoreticheskoy Fiziki (Journal of Experimental and Theoretical Physics)*, 1933, 3, (5), 447-453).—[In Russian.] Measurements of the thermoelectric power and electrical resistance of antimony-cadmium alloys show the presence of 3 ranges of composition in which these properties reach unstable maxima, indicating the existence of mixtures of compounds which are converted one into the other by heat-treatment in the solid state. The probable compositions of these are Sb_3Cd_5 , Sb_2Cd_4 , and Sb_5Cd_3 .—N. A.

***The Cobalt-Silicon Equilibrium Diagram.** Rudolf Vogel and Kurt Rosenthal (*Arch. Eisenhüttenwesen*, 1933-1934, 7, 689-691).—The system has been re-investigated between 8 and 32.45% silicon by thermal and micrographic methods. The compound Co_3Si separates from the liquid at 1210° C. and decomposes at 1160° C. The compound Co_2Si melts at 1332° C. and undergoes a transformation at 1320° C.; both forms can dissolve a little silicon but no cobalt, and the silicon-rich β -form decomposes at 1208° C. (20.8% silicon) into α -solid solution with 19.8% silicon and the compound $CoSi$, which are both stable down to room temperature. The existence of Co_3Si_2 has not been confirmed.—J. W.

***The Binary Systems Iron-Copper and Iron-Antimony.** Rudolf Vogel and Walter Dannöhl (*Arch. Eisenhüttenwesen*, 1934, 8, 39-40).—In the iron-copper system the closed gap of miscibility extends to 1180° C., and the solubility of copper in γ -iron at 1477° C. is 8% (and not 20%), and at 1094° C. 8.5%. Antimony is soluble in γ -iron up to 2%; in the region 55-65% antimony the results of Hägg obtained by X-rays have been confirmed by microscopic examination.—J. W.

***The Cu-Mg Phase in the Copper-Magnesium System.** V. G. Sederman (*Phil. Mag.*, 1934, [vii], 18, 343-352).—The β -phase of this system of alloys at 500° C. is found by X-ray analysis to extend from 84.27% copper to 82.64% copper, whilst at lower temperatures it is considerably less. This extent is somewhat less than that found by Grime and Morris-Jones, viz. 2 or 3% on either side of the Cu_2Mg composition. The alloys employed in the investigation were those used by Jones, who found by thermal and microscopic methods no evidence for the existence of a range of solubility at this point (see *J. Inst. Metals*, 1931, 46, 395).—J. S. G. T.

A New Copper-Nickel-Tin-Iron Alloy. Ivan Cerkosov (*Chem. Obzor*, 1934, 9, 9-13).—An alloy for high-pressure armatures working in superheated steam consists of copper with nickel 37, tin 9, and iron 7%, is highly resistant to corrosion, and has a high resistance to wear and a small coeff. of friction with water as a lubricant. The alloy has a Brinell hardness of 300 with a tensile strength of 40-50 kg./mm.² in the cast state, and requires no heat-treatment. The method of preparing and casting the alloy is described, and a table of physical and mechanical properties given.—R. P.

The Effect of Silver on the Softening Temperature of Copper. Anon. (*Metallurgist (Suppt. to Engineer)*, 1934, 9, 122-123).—A brief review of recent work, mainly summarizing a paper by H. C. Kenny and G. L. Craig. See *Met. Abs.*, this volume, p. 341.—R. G.

***On the Properties of Phosphor-Bronze for Springs.** Mitsugu Tanaka and Toshiichi Ogawa (*Res. Electrotech. Lab. Tokyo*, 1931, (301), 1-85; *Sci. Abs.*, 1931, [B], 34, 593).—[In Japanese.] Particular consideration is given to the properties of phosphor-bronze for springs for use in electrical instruments. Over 400 specimens of different compositions (up to 10% or 12% of tin and 0.5% of phosphorus) were annealed at various temperatures up to 600° C. The test-specimens consisted of a wire rolled and drawn from a chill-cast ingot 1 cm.² in cross-section. When reduced to 2 mm. in diameter all wires were annealed at 600° C. for 30 minutes and then cold-drawn to a diameter of 0.4 mm., thus ensuring uniform annealing of all specimens. Numerous empirical formulæ are given for the various physical and mechanical properties of the material. Details are included of a simple *extensometer* having an accuracy of 0.001 mm. with a dial gauge.—S. G.

***Elastic Fatigue and Creep of Coiled Springs [of Phosphor-Bronze].** W. H. Pielemeier (*Science*, 1933, 78, 511).—A note. Two ordinary jolly balance springs of phosphor-bronze under a continuous load of 50 gm. showed increases in length of 0.03 and 0.23 cm., respectively, after 6 months, the former being equivalent to about 0.08% of the length of the spring. This creep was much less than that shown by springs made of steel piano wire, which were quite unsuitable for balance springs subjected to continuous loading.—W. H.-R.

***Some Investigations on Cast Alloys. V.—Perkins Metal.** Gunji Shinoda (*Suiyō-Kwaishi*, 1929, 6, (1), 42-47; *Japanese J. Eng. Abs.*, 1933, (9), 69).—[In Japanese.] The effect of annealing on the electrical resistance of cast bronzes containing 18-24% of tin was studied. The results reported in a previous paper (*ibid.*, 1928, (4), 687) for quenched alloys was also observed for chill-cast alloys, although the phenomena were less remarkable. The specific resistance-concentration curve was obtained; its general shape did not differ essentially from that of Stephen's later experiments, except for a small kink corresponding to Cu₃Sn₂ and CuSn. The electric potential of the tempered alloy containing 24% tin was measured and S. found an intimate relation between this and the microscopic structure due to tempering, *i.e.* he considered the reaction rims surrounding the martensitic needles must be a kind of tin-rich solid solution and that the specific resistance must be less than that of Cu₄Sn. From this point of view S. explains the remarkable minimum at about 340° C. Laue photographs were taken of all the specimens and the change of internal structure was studied. The effect of tempering first appeared at about 200° C. and from 300° C. the structure became fibrous.—S. G.

***The Mechanical Properties of the Copper-Zinc Alloys.** W. Broniewski and S. Trzebski (*Rev. Fonderie moderne*, 1934, 28, 173-178).—An investigation of the mechanical properties of unoxidized brasses containing up to 44% zinc has been undertaken. In the case of the alloys annealed at 550° C.; the hardness, tensile strength, and elastic limit curves show a horizontal part between 20 and 36% zinc, preceded and followed by rising sections; the elongation has successively a minimum and a maximum towards 13-32% zinc; the reduction of area curve shows a sharp fall beginning at 40% zinc; the elongation and resilience only vary slightly with the composition. Cold-working considerably reduces the elongation and makes it nearly independent of the composition; the hardness and tensile strength are increased, but the curves preserve the general direction of those of the annealed alloys. Oxidation of the alloys affects the mechanical properties of chiefly the 12-35% brasses; the elongation, reduction of area, and resilience are reduced, but the hardness and tensile strength are increased.—J. H. W.

†**Bearing Metals on the Railways of the United States of America and Their Recent Development (Satco Metal).** Fr. Witte (*Z. Metallkunde*, 1934, 26, 69-70).—The properties of the lead-base bearing alloy Satco metal are

compared with those of tin, lead, and antimony bearing alloys. Satco metal consists of lead with (preferred composition in brackets) tin 0.5-2 (1), calcium 0.3-1 (0.5), mercury 0.1-0.5 (0.25), aluminium 0.02-1 (0.05), magnesium 0.05-0.1 (0.075), potassium 0.02-0.06 (0.04), and lithium 0.02-0.06 (0.04)%. The bending strength is 1740-1870 kg./mm.², the Brinell hardness 24-27 (20° C.), 17-19 (100° C.), and 10-14 kg./mm.² (150° C.), and melting begins at 315° C. Further information on the tensile strength, elongation, and deformation under load is given. The life of Satco metal bearings is 75,000-300,000 km., compared with 45,000-75,000 km. for ordinary bearings.—B. Bl.

*Some Investigations on Magnesium-Aluminium Alloys. Shirō Ishida (*J. Mining Inst. Japan*, 1930, 46, (540), 245-268; *Japanese J. Eng. Abs.*, 1934, (10), 45).—[In Japanese.] The solid solubility of aluminium in magnesium was determined by microscopic study and determinations of electrical resistance and thermal expansion. It was found to be about 13% at the eutectic temperature and to decrease to 5% at room temperature. The effect of quenching and tempering was investigated by microscopic examination and the measurement of physical and mechanical properties. The alloys containing more than 7% of aluminium harden by quenching and tempering, and the structures are troostitic. Maximum hardening occurred at 150°-170° C. but the temper-hardened alloys are too brittle to be used under shock. I. recommends that they be cooled in the furnace after heating at higher temperatures.—S. G.

*Solid Solubility of Aluminium and Zinc in Magnesium in Relation to Temperature. P. J. Saldau and V. S. Sokolov (*Trudi Nauchno-Issledovatel'skogo Instituta Legkih Metallov*—"NIISALUMINI" (*Transactions of the Scientific Research Institute for Light Metals*—"NIISALUMINI," 1932, (1-2), 57-62).—[In Russian.] From a microscopic examination of alloys annealed for 24 days *in vacuo* at different temperatures and quenched, the limits of solid solubility of aluminium and zinc (1:1 weight ratio) in magnesium have been found to be: at room temperature, 1.1 and 1.6; at 250° C., 2.45 and 2.85; at 300° C., 2.30 and 2.75; at 350° C., 4.30 and 4.60; and at 400° C., 3.04 and 4.0%, respectively, whence the values at the eutectic temperature (351° C.) are deduced to be 4.5% for both metals.—D. N. S.

*Solid Solubility of Zinc and Aluminium in Magnesium in Relation to Temperature. P. J. Saldau and N. I. Korenev (*Trudi Nauchno-Issledovatel'skogo Instituta Legkih Metallov*—"NIISALUMINI" (*Transactions of the Scientific Research Institute for Light Metals*—"NIISALUMINI"), 1933, (3), 60-64).—[In Russian.] Microscopic examination of magnesium alloys (with a 3:1 weight ratio of aluminium and zinc) annealed for 24 days and quenched in water, showed the limiting solubility of these metals to be: at 20° C., 3.9 and 1.31; at 250° C., 4.84 and 1.66; at 325° C., 6.57 and 2.14; at 350° C., 7.57 and 2.50%, respectively.—D. N. S.

*An Investigation on Some Magnesium Alloys. Shirō Ishida (*J. Mining Inst. Japan*, 1929 (529), 256-268; (532), 611-621; (536), 786-790; *Japanese J. Eng. Abs.*, 1933, (9), 68).—[In Japanese.] From the results of thermal and microscopic investigations, I. confirmed the constitutions of the magnesium-aluminium, magnesium-cadmium, magnesium-copper, and magnesium-zinc alloys. The limit of solubility of aluminium was found to be about 5% at room temperature and 13% at the eutectic temperature; the solubility of zinc in magnesium was observed to be about 3% at 200° C. and 7% at 300° C. The alloy containing 55% zinc solidified as a white solid solution but transformed a few degrees below the crystallization temperature into a eutectic structure. The systems magnesium-aluminium-cadmium, magnesium-zinc-aluminium, and magnesium-zinc-copper were also studied. In the two latter a ternary compound was found but the formula was not determined. Some experiments were carried out on the melting of mag-

nesium alloys by various methods. It is concluded that magnesium manufactured by the electrolysis of magnesium oxide can be melted without cover, but for magnesium prepared by the electrolysis of magnesium chloride it is better to use a cover such as carnalite or a mixture of carnalite and sodium chloride. The mechanical properties of alloys made by the latter method were always better, but it is necessary to take precautions to prevent the salt from entering the alloy and to protect it from the action of sulphur dioxide.—S. G.

***The Iron Corner of the System Iron-Manganese-Chromium.** Werner Köster (*Arch. Eisenhüttenwesen*, 1933-1934, 7, 687-688).—Up to 40% manganese and 30% chromium only the α - and γ -solid solutions exist. The equilibrium diagram of this region has been constructed from measurements of the thermal expansion and from micrographic examination.—J. W.

***Forced Life Test of Heating Wires.** Shinji Togō (*J. Illuminating Eng. Soc. Japan*, 1929, 13, (4), 201-207; *Japanese J. Eng. Abs.*, 1933, (9), 34).—[In Japanese.] See *Met. Abs.*, this volume, p. 73.—S. G.

***Life of Resistance Wires for Electric Heaters.** Masaie Horioka, Kenichi Yamamoto, and Komazō Honda (*J. Inst. Elect. Eng. Japan*, 1931, (518), 645-654).—[In Japanese.] See *J. Inst. Metals*, 1932, 50, 298.—S. G.

Remarks on the Equilibrium Diagram of the Iron-Nickel System Below 1000° C. L. Grenet (*Aciers spéciaux*, 1934, 9, 76-83).—The iron-nickel diagram is critically reviewed and the results of X-ray observations are discussed. It is concluded that it is difficult to conceive a continuous evolution from the homogeneous α -phase to the homogeneous γ -phase with a crystalline system, as with an amorphous system, or a rapid variation from the cube-centred to the face-centred cube. It is suggested that the notion of phases be separated from the notion of a crystalline state, and the coexistence of individualities and not phases be envisaged. This hypothesis is expanded further and the grounds on which it is based are explained.—J. H. W.

Lines of Research in the Field of High-Resistance and Heat-Resistant Alloys. A. A. Botchvar (*Vestnik Ingenerov i Technikov (Messenger of Engineers and Technologists)*, 1933, (8), 340-341).—[In Russian.]—N. A.

***On the Absorptive Power of the Palladium-Boron Alloys for Hydrogen.** Adolf Sieverts and Kurt Brüning (*Z. physikal. Chem.*, 1934, [A], 168, 411-418).—Alloys with up to 6.9 atomic-% boron are homogeneous after heat-treatment, but alloys with 13.8 and 16.6 atomic-% boron consist of two phases; the hardness increases with the boron content at first rapidly then more slowly. The absorptive power of the alloys for hydrogen decreases in all cases with rise of temperature; at constant temperature the amount of gas absorbed is approximately proportional to the square root of the pressure except in the case of alloys low in boron, above 500° C. At 20° and 100° C. the absorptive power of the alloys decreases with increasing boron content. Between 160° and 900° C. the absorptive power increases to a maximum at 7 atomic-% boron, then decreases again. The behaviour of boron-palladium alloys is very similar to that of gold-palladium alloys.—B. Bl.

***Alloys of Palladium with Nickel.** A. T. Grigoriev (*Izvestia Platinago Instituta (Annales de l'Institut de Platine)*, 1932, (9), 13-22).—[In Russian.] The system has been studied by micrographic examination and by measurement of the Brinell hardness and temperature coeff. of electrical resistance. The hardness curve is characteristic of a continuous series of solid solutions, the maximum hardness (156) being reached with 60-64 atomic-% palladium. The structure consists of polyhedral grains typical of solid solutions. The curve of temperature coeff. of electrical resistance has a sharp break at 70.8 atomic-% palladium, corresponding with the transition from magnetic to non-magnetic alloys.—N. A.

***Alloys of Platinum and Cobalt.** V. A. Nemilov (*Izvestia Platinago Instituta (Annales de l'Institut de Platine)*, 1932, (9), 23-30).—[In Russian.] See *J. Inst. Metals*, 1933, 53, 494.—N. A.

White Bearing Metals. Mark R. Pitt (*J. Inst. Eng. Australia*, 1932, 4, 430-434).—A review of the tin- and lead-base bearing metals, their structure, properties, and behaviour in service.—R. G.

The White Alloys of Tin. IV.—**Britannia Metal.** Anon. (*Tin*, 1934, June, 8-9).—Briefly describes the properties of Britannia metal, Ashberry metal, and "Falun" or Falun Brilliants.—J. H. W.

***The System Iron-Fe₃C-ZrC-Fe₃Zr₂.** Rudolf Vogel and Karl Löhberg (*Arch. Eisenhüttenwesen*, 1933-1934, 7, 473-478).—The iron-zirconium-carbon system has been investigated up to 6% carbon and 30% zirconium by thermal and micrographic methods. The results are shown in a ternary equilibrium diagram.—J. W.

***Comparative Fluidity Tests.** Ernst Scheuer (*Metallwirtschaft*, 1931, 10, 884-885; *C. Abs.*, 1932, 26, 677).—The apparatus used was similar to that developed by Guillet and Portevin, in which the metal is cast under definite conditions at constant hydrostatic pressure into a spiral-shaped mould. The fluidity is measured by the length of the mould which is filled out with the metal. The fluidity of zinc, aluminium, and Silumin increases proportionally with the pouring temperature. Mould temperature has little influence up to 300° C.; above that it increases the fluidity. The smoothness of the mould surface has practically no influence. The fluidity of the binary alloys of aluminium with silicon, copper, zinc, and nickel was investigated. In each case small additions of the respective metals lower the fluidity of pure aluminium. With further additions it increases again, approximately up to the eutectic point, after which it remains almost constant. Additions of cadmium and nickel up to 1.5% to Silumin increase its fluidity by about 10%. Magnesium, copper, zinc, and manganese have little or no effect. Additions of magnesium up to 2% to a 13% aluminium-copper alloy decreases the fluidity slightly, further additions increase it. The decreased fluidity is explained by the formation of a solid solution, and the increase with higher additions by the formation of a eutectic. —S. G.

***Measurement of the Viscosity of Molten Metals and Alloys by the Rotating Cylinder Method.** Daikichi Saitō and Tatsuo Matsukawa (*Tetsu-to-Hagane (J. Iron Steel Inst. Japan)*, 1931, 17, (5), 502-532).—[In Japanese.] Cf. *J. Inst. Metals*, 1933, 53, 435.—S. G.

***Permeability Changes in Ferromagnetic Materials Heat-Treated in Magnetic Fields.** G. A. Kelsall (*Physics*, 1934, 5, 169-172).—Very high maximum magnetic permeability has been obtained in ferromagnetic alloys by slowly cooling them in a magnetic field. In Permalloy containing 78.5% nickel the permeability has thus been raised above 140,000, *i.e.* to the same order as is obtainable by rapid cooling without an applied field. Similar magnetic heat-treatment is likewise effective in the case of Perminvar containing 45% nickel, 30% iron, and 25% cobalt. The maximum permeability is highest if the testing field is in the same direction as that applied during cooling. In directions at right angles to this, the maximum permeability is decreased. The ratio of these two permeabilities was in one case more than 14 for Perminvar and in another case almost 70 for the same alloy.—J. S. G. T.

***Magnetic Properties and Chemical Compounds in Alloys.** J. G. Dorfman (*Zhurnal eksperimentalnoy i teoreticheskoy Fiziki (Journal of Experimental and Theoretical Physics)*, 1933, 3, (4), 293-302).—[In Russian.] See *J. Inst. Metals*, 1933, 53, 626.—N. A.

III.—STRUCTURE

(Metallography; Macrography; Crystal Structure.)

(Continued from pp. 384-385.)

Some Statistical Properties of an Annealed Alpha-Grain Aggregate.—II. R. G. Johnston and W. G. Askew (*Met. Ind. (Lond.)*, 1934, **45**, 27-30).—It is shown that the arithmetical grain area or mean grain diameter as a specification of grain pattern is irrational and leads to unreliable and conflicting results when correlating the properties of an α -brass with its grain size. It is suggested that the absolute size of the largest grain to be tolerated be used as a basis of a complete method of specification, perhaps in conjunction with one or more mean quantities.—J. H. W.

Notes on the Metallography of Light Metal Alloys. A. Blumenthal (*Zeiss Nachrichten*, 1934, April, 28-34; and (translation) *Metallurgia*, 1934, **10**, 83-85).—The technique employed in the metallographic investigation of some light metal alloys including Silumin, K.S.-Seewasser, the Elektron die-casting alloy A.Z. 91, and other casting alloys is described.—J. W. D.

***A Metallographic Investigation of Native Silver.** (Sir) H. C. H. Carpenter and M. S. Fisher (*Trans. Inst. Min. Met.*, 1932, **41**, 382-403; discussion, 403-433).—See *J. Inst. Metals*, 1932, **50**, 362.—S. G.

***On the Twinning of Zinc.** N. N. Davidenkov, A. F. Kolesnikov, and K. N. Fedorov (*Zhurnal eksperimental'noy i teoreticheskoy Fiziki (Journal of Experimental and Theoretical Physics)*, 1933, **3**, (4), 350-360).—[In Russian.] When single crystals of zinc are stretched at temperatures between -185° and $+200^{\circ}$ C. under conditions of orientation favourable to twinning the resistance to twinning, manifested as a shear stress along the plane and in the direction of twinning, is 5-11 times the resistance to slip along the basal plane and much less constant. Probably resistance to twinning is affected by the normal extension stresses acting along the twinning plane and arresting the process. Lowering the temperature increases resistance to twinning more than resistance to slip.—N. A.

***Abnormal Structures in Slowly Cooled Alloys of the Eutectic Type.** A. A. Botchvar and K. V. Rusetsky (*Vestnik Metallopromishlennosti (Messenger of the Metal Industry)*, 1933, (1), 59-61).—[In Russian.] Abnormal structure of alloys of the eutectic type is characterized by the appearance of "halos" of the second phase, surrounding primary crystals. Both hypo- and hyper-eutectic alloys of bismuth, cadmium, lead, and tin were investigated. In this series each metal forms halos round the metals which precede it, the further apart the metals in the series the sharper being the halo.—D. N. S.

***On the Crystallization of Ternary Eutectics.** A. A. Botchvar and K. V. Gorev (*Vestnik Metallopromishlennosti (Messenger of the Metal Industry)*, 1933, (2), 44-45).—[In Russian.] Cf. *J. Inst. Metals*, 1933, **53**, 238. Experiments are described to ascertain the order in which the different phases crystallize in the ternary eutectics, lead-tin-cadmium, bismuth-tin-cadmium, and bismuth-lead-cadmium. The order of crystallization irrespective of the presence of an excess of one component is cadmium, lead, tin, bismuth.

—D. N. S.

***An X-Ray Investigation of the Arsenic-Tin System of Alloys.** W. H. Willott and E. J. Evans (*Phil. Mag.*, 1934, [vii], **18**, 114-128).—The crystal structures and lattice constants of the complete range of arsenic-tin alloys are determined by X-rays analysis. The results show that the phase from 0 to 29.5% of arsenic is a solid solution, and not a mixture of tin and Sn_3As_2 . There is no evidence of the presence of the compound Sn_3As_2 . The compound SnAs has a sodium chloride structure, which persists as a homogeneous phase over the

range 34.5–49.0% of arsenic and is accompanied by changes of lattice constant, indicating that the compound SnAs dissolves both tin and arsenic. The sodium chloride structure has a range extending from 29.5 to 68.0% of arsenic, indicating the presence of two mixture phases, one extending from 29.5 to 34.5% of arsenic, and the other from 49.0 to 68.0% of arsenic. The existence of a solid solution of tin in arsenic is confirmed.—J. S. G. T.

***X-Ray Crystal Measurements of Nickel at High Temperatures.** William P. Jesse (*Physics*, 1934, 5, 147–149).—X-ray powder photographs of an electrically heated nickel ribbon showed no new high-temperature crystal form of nickel between 450° C. and 1200° C. The thermal expansion of the face-centred cubic lattice is in agreement with macroscopic thermal expansion data.—J. S. G. T.

***On Osmiridium. II.—X-Ray Analysis.** O. E. Zviagintzev and B. K. Brunnovskiy (*Izvestia Platinago Instituta (Annales de l'Institut de Platine)*, 1932, (9), 49–53).—[In Russian.] Cf. *J. Inst. Metals*, 1933, 53, 352. Osmiridium of various origins and compositions has a close-packed hexagonal lattice, like osmium: $a = 2.620\text{--}2.90$ A., $c = 4.235\text{--}4.60$ A., $c/a = 1.581\text{--}1.617$. Some of the atoms in the osmium lattice can be replaced by up to 51% of iridium and platinum without altering its character. Osmiridium must therefore be regarded as a solid solution of iridium (and platinum) in osmium.—N. A.

***An Electrochemical and X-Ray Investigation of Solid Thallium-Lead Alloys.** Arne Ölander (*Z. physikal. Chem.*, 1934, [A], 168, 274–282).—The potential of the cell $\text{Tl}_{\text{solid}} | (\text{Na}, \text{K}, \text{Tl})\text{CH}_3\text{CO}_2 | (\text{Tl}, \text{Pb})_{\text{solid}}$ and its temperature coeff. between 245° and 295° C. has been measured for 41 alloys. The results together with X-ray examination of the alloys indicate that in alloys up to 54.6% thallium the thallium atoms are distributed at random in the lead lattice. Between 54.6 and 92.5% thallium the intermediate phase Tl_2Pb exists. The lattice parameter of the lead-rich phase is given by the expression $a = 4.9380 - 0.0758[\text{Tl}]$, and that of the thallium-rich phase by the expression $a = 4.9794 - 0.1516[\text{Tl}]$, where $[\text{Tl}]$ is the concentration of thallium in the lead. These two straight lines intersect at $[\text{Tl}] = 0.546$.—B. Bl.

***Mechanism of Formation of Hard Alloys in the Light of Modern Crystallographic Chemistry.** V. I. Riskin (*Redkie Metalli (Rare Metals)*, 1933, (3), 3–9).—[In Russian.] An account of modern theories of crystal structure and their application to the formation of metal carbides. The relation between the atomic radii of metals and carbon and the crystalline structure of carbides is examined. The results of these calculations are applied to the theoretical selection of new hard carbide alloys.—D. N. S.

***Laminated Fracture in Super-Hard Alloys of the Metallo-Ceramic Type.** N. M. Zarubin and V. I. Tretiakov (*Redkie Metalli (Rare Metals)*, 1933, (3), 16–21).—[In Russian.] Discusses the macro- and micro-structures of fractures of the hard alloys Pobedit, Carboloy, and Widia. The laminated fracture is explained primarily by the presence of free carbon in the alloys and the decarburization due to irregularities in the sintering process of production of the alloys.—D. N. S.

***Optical Method of Determining the Orientation of Single Crystal Specimens.** E. S. Yakovleva (*Zhurnal eksperimentalnoy i teoreticheskoy Fiziki (Journal of Experimental and Theoretical Physics)*, 1933, 3, (5), 454–459).—[In Russian.] A modification of A. W. Schubnikov's method (*Z. Krist.*, 1931, 78, 111) is described for the determination of the inclination of any face of a metal crystal to the axis of the specimen and its crystallographic index. The apparatus, preparation of specimens, method of etching, experimental procedure, and calculation of the results are described. The results are accurate to 30'–1".—N. A.

IV.—CORROSION

(Continued from pp. 385-387.)

Behaviour of Aluminium in Laundry Work. Anon. (*Illust. Zeit. Blech-industrie*, 1934, 63, 740).—A summary of the work of Bohmer on the attack of aluminium and certain light alloys in soapy and alkaline solutions. It is found that soft aluminium (99.5%) suffers less attack than hard; that alloying increases susceptibility, as does increase in temperature: that the presence of other metals, especially copper and zinc, very greatly increases the speed and violence of attack and that the action is almost completely inhibited if sodium silicate is present in sufficient quantity. As many washing preparations contain sodium silicate it should be possible to utilize aluminium and its alloys in laundry vessels to a greater extent than has hitherto been considered possible. —P. M. C. R.

***Poisoning and Activation of Aluminium and Cadmium During Dissolution in Hydrochloric Acid.** K. Jablczynski and T. Pierzchalski (*Z. anorg. Chem.*, 1934, 217, 298-304).—Thiocyanates and thiourea retard considerably the rate of dissolution of aluminium in hydrochloric acid, but urea is without effect, and hydrogen sulphide and carbon bisulphide activate the solution. Potassium cyanide reduces the rate of dissolution, whereas iodine activates aluminium. Potassium chloride and sulphate, aluminium, and iron chlorides also assist the reaction. Thiocyanates and thiourea activate cadmium, as also does iodine, but urea and potassium cyanide are inert.—B. Bl.

***Corrosion of the Bimetal "Ferran."** V. S. Zorin (*Trudi Nauchno-Issledovatel'skogo Instituta Legkih Metallov—"NIISALUMINI"* (*Transactions of the Scientific Research Institute for Light Metals—"NIISALUMINI"*), 1932, (1-2), 74-81).—[In Russian.] The corrosion of the bimetal Ferran by sodium chloride, sodium carbonate, and acetic acid solutions, dilute sulphuric acid, tap-water, ammonia gas, hydrogen sulphide, carbon dioxide, foodstuffs, and fish products was investigated. In all cases the aluminium layer was found to be porous, the porosity being inversely proportional to its thickness and giving rise to pitting by all the liquid reagents. Sodium carbonate solution produced stripping of the aluminium layer. The gases gave no corrosion. —D. N. S.

***Plating of Iron with Aluminium.** N. N. Ivanov-Skoblikov (*Trudi Nauchno-Issledovatel'skogo Instituta Legkih Metallov—"NIISALUMINI"* (*Transactions of the Scientific Research Institute for Light Metals—"NIISALUMINI"*), 1933, (5), 3-31).—[In Russian.] "Ferran" has been compared with sheet iron plated with aluminium on one side by rolling together iron and aluminium sheets under certain conditions; these have been critically studied and the products examined under the microscope. "Ferran" is not resistant to corrosion by many reagents, but foodstuff containers made from aluminium-plated sheet showed no corrosion or deterioration of their contents after 2 years' storage.—D. N. S.

***Corrosion of the Bimetal Iron-Copper.** V. S. Zorin (*Trudi Nauchno-Issledovatel'skogo Instituta Legkih Metallov—"NIISALUMINI"* (*Transactions of the Scientific Research Institute for Light Metals—"NIISALUMINI"*), 1933, (5), 44-50).—[In Russian.] Corrosion tests on sheet (1-2 mm.), strip, and various utensils of a composite metal produced by rolling sheet iron between two copper sheets and subsequently tinning, have been made in tap-water and solutions of sodium chloride, sodium carbonate, acetic acid, and malic acid. Owing to its plastic nature, the copper layer (0.08-0.17 mm. thick) is non-porous, and hence does not give an iron-copper couple which promotes corrosion, and does not peel off the iron. The mechanical

properties of the composite sheet are unaltered after the corrosion tests, and it is considered to be a suitable substitute for pure copper in cooking utensils.

—D. N. S.

***Corrosion of Lead by Fatty Acids in Presence of Iron.** G. O. Heyer (*Seifensieder-Zeit.*, 1933, 60, 131–133, 165–167; *Res. Assoc. Brit. Paint Manuf. Rev.*, 1933, (32), 88).—A case of corrosion of the lead lining of an iron vessel is described. On removing the corroded lead lining small pits were found on the surface next to the iron and the narrow space between the 2 metals was found to be little-changed fatty acid which had previously leaked into it. On removing the fatty acid, the lead surface was seen to be much corroded. The theory is advanced that the cause of corrosion is to be found in the system lead–iron–fatty acid. Apparatus to investigate the cause of the above corrosion is described. Small lead plates are bent to fit on to similar plates of iron and the metals alone and fitted together are immersed in beakers containing oleic acid and oleic acid + water. Data are recorded to show the loss in weight of the lead plates under the 4 conditions over a period of 9 months. The loss was considerably greater when iron was present than when the lead alone was immersed in oleic acid and the loss is greater still in presence of water. Curves in which loss in weight per unit area is plotted against time are regular and tend to flatten out. The inference is that the lead surface becomes coated by a protective layer and oleic acid attack falls off.—S. G.

Protection Against Lead Poisoning from Water Supplies. J. A. Cancik (*Mem. Soc. Roy. Sci. Bohême*, 1932, (5), 1; *Zbl. ges. Hyg.*, 1933, 29, 14; (*U.S.*) *Public Health Eng. Abs.*, 1934, 14).—Discusses factors favouring the corrosion and erosion of lead and its occurrence in water supplies. Small variations in the properties, particularly the p_H , of a water are always occurring and may cause it to become plumbo-solvent. Individual susceptibility to lead poisoning varies and drinking water should be so far as possible free from lead. Protective measures usually taken are increasing the hardness or alkalinity of the water or lining the pipes, as the coating is easily destroyed and hydrogen sulphide may be formed. A strong lining of tin is the only safe method for protecting the pipes.—S. G.

***The Corrosion and Protection of Magnesium and Its Light Alloys (with Discussion).** Guy D. Bengough and L. Whitby (*Trans. Inst. Chem. Eng.*, 1933, 11, 176–190).—See *Met. Abs.*, this volume, p. 179.—A. B. W.

The Corrosion of Tin Cans used as Food Containers. S. G. Lipsett (*Canad. Chem. and Met.*, 1933, 17, 171; *Res. Assoc. Brit. Paint Manuf. Rev.*, 1933, (35), 277).—Electrolytic action on the tin–iron junction is reversed in the absence of air, the tin dissolves preferentially in acid solutions. Cans are therefore not especially liable to perforation at pinholes in the tin coating. Lacquered cans are less reliable in this respect.—S. G.

***The Rate of Dissolution of Electrolytic Zinc in Acids.** M. Centnerszwer and M. Straumanis [with Frln. E. Karau] (*Z. physikal. Chem.*, 1934, [A], 167, 421–430).—The rate of dissolution of chemically pure electrolytic zinc in acids is lower than that of Kahlbaum's zinc and almost the same as that of zinc with 0.2% cadmium. Zinc that has been roughened with emery dissolves at the maximum rate as soon as it is immersed in the acid, but the rate rapidly decreases, and reaches a limiting value characteristic of the acid and the nature of the metal. Chemical activation of the surface is not so effective as mechanical treatment with emery. The reactivity of zinc is not affected by storage in water. The rate of dissolution of electrolytic zinc in hydrochloric acid is a linear function of the concentration up to 2N, i.e. $dv/dt = K(C - C_0)$, where C_0 is the concentration of acid at which dissolution commences, C is the concentration of the acid tested, and K the dissolution constant. In sulphuric acid dissolution is slower than in hydrochloric acid of the same p_H , and in both cases is independent of the current density used

in the preparation of the metal. From the magnitude of the temperature coeff. of the rate of dissolution and from the fact that stirring is without effect, it follows that the reaction is controlled by the chemical partial process and not by diffusion of the acid.—B. Bl.

***On the Corrosion of Electrolytic Zinc and Refined Zinc.** O. Bauer and G. Schikorr (*Z. Metallkunde*, 1934, **26**, 73–80).—Comparative corrosion tests have been made on electrolytic zinc (99.98% zinc) and on two grades of refined zinc (98.86 and 99.00% zinc). Electrolytic zinc is less attacked than refined zinc in neutral waters; in pure water the presence of carbon dioxide to produce a protective film is important. In acid solutions from which zinc liberates hydrogen electrolytic zinc is generally more rapidly attacked than refined zinc, whereas no difference in the behaviour of the three grades can be detected in atmospheric corrosion or in alkaline solutions (soda, Persil). Atmospheric attack is least in pure forest air, increases in the neighbourhood of towns, and is greatest in the ventilator shafts of laboratories. No differences are detectable in the corrosion of sheets hung perpendicular or horizontal except in the moist air of greenhouses, where horizontal sheets were more attacked than vertical ones. All grades of zinc are equally strongly attacked by moist gypsum, but electrolytic zinc is slightly more vigorously attacked by moist cement than is refined zinc. Among moist woods basswood has the greatest corrosive action on zinc and beechwood the least. Moist pinewood attacks electrolytic zinc more strongly than refined zinc.

—B. Bl.

***Internal Corrosion of Zinc.** E. Arendt (*Compt. rend.*, 1934, **199**, 142–143).—Although zinc immersed in an acidified solution becomes passive, if left in sulphuric or hydrochloric acids (the concentration within a large range is immaterial) for some weeks, it becomes corroded internally. The corroded metal in the interior is partly dissolved as the salt and partly oxidized to $Zn(OH)_2$, which fills the cavities formed by the corrosion. The passive film has a metallic appearance on the surface in contact with the solution and the colour of the hydrate on the internal face, and is about 10μ thick. This effect of the passive film is much more marked in commercial zinc than in the chemically pure metal. The internal corrosion of the metal is facilitated by the difference in chemical properties of the surface films and the interior metal. When the metal is made passive over the whole surface, corrosion is caused by the diffusion of negative ions through the passive film and then reaction with the deeper layers. As a result, hydrogen is liberated and breaks through the film.—J. H. W.

***Alloys Stable in Phosphoric Acid.** O. I. Vehr and M. M. Romanov (*Dokladi Akademii Nauk (Compt. rend. Acad. Sci. U.R.S.S.)*, 1933, [N.S.], (3), 111–117).—[In Russian.] The following alloys were found to be resistant to hot and cold phosphoric acid (up to 60%): chromium steel (carbon 0.63, silicon 2.27, chromium 32.92%), chromium–manganese steel (carbon 0.23, chromium 16.45, manganese 11.54%), aluminium–bronze with 0.6% chromium. Aluminium–bronzes containing 0.02–0.67% chromium as well as plain “aluminium–bronze” and “aluminium–bronze” with 3% iron were tested in 80% phosphoric acid at the boiling point and at $135^\circ C.$, and in technical phosphoric acid at $15^\circ C.$ All the alloys had previously been heat-treated by quenching from $900^\circ C.$ and normalizing at $700^\circ C.$ The influence of chromium is manifested in two ways: by the formation of a protective film by the action of the acid and by a refining of the grain-size. All the “aluminium–bronzes” are resistant at room temperature to pure and commercial phosphoric acid. In 80% acid at 135° – $140^\circ C.$ the bronze containing 0.5% chromium was the most resistant. A bronze containing aluminium 9.46, chromium 0.37, and iron 0.26% prepared by the addition of ferro–chromium to “aluminium–bronze” was highly resistant to boiling 87% acid. The mechanical properties of

"aluminium-bronzes" containing chromium are good; after heat-treatment the tensile strength is 70 kg./mm.² and the elongation 25%.—N. A.

***The Influence of Metals on Milk and of Milk on Metals.** W. Mohr, R. Kramer, A. Burr, — Osterburg (*Alluminio*, 1934, 3, 80-82).—Presented at the 10th International Dairy Congress, Rome, 1934. The corrosion of various metals and alloys by milk, and the changes thereby produced in the milk have been studied. Various light alloys, especially those the surfaces of which have been treated by the Eloxal process showed no signs of corrosion. Methods of preventing electrolytic corrosion by contact with other metals and the action of various alloy couples are discussed.—G. G.

***The Corrosive Action of Refrigerating Salt Mixtures on Various Metals.** A. Burr and M. Miethke (*Alluminio*, 1934, 3, 82-84).—Read at the 10th International Dairy Congress, Rome, 1934. Refrigerating mixtures with a basis of calcium chloride have the most corrosive action even on stainless steel, the least corrosive mixture is a proprietary product containing chromate.—G. G.

***Metals and Wines. Corrosion-Resistance of Metals in Wine Making and Tolerance of Wines for Metals.** H. E. Searle, F. L. La Que, and R. H. Dohrow (*Indust. and Eng. Chem.*, 1934, 26, 617-627).—Corrosion-resisting metals offer important advantages over the older materials of construction of winery equipment. Tests made to ascertain the resistance of metals to corrosion by wine and their effect on the product, are described. Inconel and 18:8 chromium-nickel steel were almost perfectly resistant under all the conditions studied. Inconel is adequate for all winery uses. The pick-up of iron from 18:8 alloy storage tanks, closed fermenters, and blending tanks may exceed the tolerance of wines for iron; in all other stages of the process this alloy is adequate. Owing to the high tolerance of wine for nickel, this metal may be used almost throughout the winery without affecting the colour, brilliance, flavour, or bouquet of wine. Monel metal, aluminium, and copper may be employed in certain winery equipment, e.g. juice tanks, in which the liquid does not remain for long periods. These metals as well as copper alloys are now used in pipe-lines, pumps, filling machines, &c. Tin is the only metal tested which appears to have a very limited application in wineries. Wine will tolerate only small quantities of tin, and the metal has a comparatively high corrosion rate, particularly when exposed to red wine under conditions of low aeration.—F. J.

***Corrosion of Metals by Phenols.** F. H. Rhodes, P. A. Riedel, and V. K. Hendricks (*Indust. and Eng. Chem.*, 1934, 26, 533-534).—A method for determining the rates of corrosion of various metals and alloys in phenol and the cresols is described. In the stills used for refining these substances the metal of the condenser coils must resist the chemical action of the vapour, and must not discolour the finished product. The corrosive action of the acids on metal is also of importance in connection with the operation of the processes for the purification of petroleum oils by fractional extraction with cresol. The results showed that nickel or the 18:8 chromium-nickel steels should be satisfactory for use in handling and condensing the vapours of phenol or the cresols. Lead is rapidly attacked by the tar acid, and should not be used in handling these materials. The use of copper in phenol stills and containers for phenols at ordinary temperatures should be avoided, both because the copper itself is attacked to a considerable extent and also because the products of the action of the tar acids on copper cause discoloration of the phenol or cresol. Commercial zinc, aluminium, Monel metal, pure electrolytic silver, high-carbon and low-carbon steel, brass, and high-chromium steel were also used in the investigation.—F. J.

Corrosion of [Oil] Production Equipment in the Gulf Coast. S. Gill (*Oil Weekly*, 1933, 69, 51).—Corrosion of well equipment, which constitutes one

of the most serious items of trouble and expense in the Gulf Coast area, is discussed.—S. G.

Chemical Injection in Kansas [Oil] Wells Retards Corrosive Action. Anon. (*Oil Weekly*, 1933, 70, (3), 22; *J. Inst. Petrol. Tech.*, 1933, 19, 313A).—Difficulty is experienced in one of the Kansas fields through the presence of hydrogen sulphide and a low concentration of salt in the water coming with the oil from the deep producing horizons. Continued pulling of tubing, casing, &c., has been necessary since the oil was discovered in that region. An attempt was made to manufacture some alloy which would not be attacked but these measures failed. Injection of chemicals into the hole was then studied and is now being carried out to retard corrosion.—S. G.

Corrosion Test for Liquid Butane. F. M. Clothier (*Nat. Petrol. News*, 1933, 25, 22; *J. Inst. Petrol. Tech.*, 1933, 19, 411A).—This is an adaptation of the corrosion test for gasoline (copper strip) A.S.T.M. D 130-30, and is for the purpose of detecting the presence of free sulphur or corrosive sulphur compounds in commercial butane.—S. G.

Testing of Fuels, Solvents, and the Like for Corrosive Sulphur by Means of Copper. H. Kiemsted (*Brennstoff-Chem.*, 1933, 14, 284-286).—S. G.

The Phenomenon of Corrosion. J. Liger (*Galvano*, 1934, (26), 18-20).—A discussion of general principles.—E. S. H.

***The Velocity of Corrosion from the Electrochemical Standpoint.—III.** U. R. Evans and R. B. Mears (*Proc. Roy. Soc.*, 1934, [A], 146, 153-165).—It is shown that Bengough's "film distribution" view of corrosion has much in common with views published by E. and M., and can be, in part, accepted. Criticisms of the differential aeration theory based on Bengough's linear corrosion-time curves are invalid. In the corrosion of iron immersed vertically in potassium chloride solution below oxygen-nitrogen mixtures, the velocity of corrosion *increases* and the area affected *decreases* with the oxygen concentration, thus confirming Borgmann's results (*Trans. Faraday Soc.*, 1932, 28, 813). A statistical study of drops of potassium chloride on iron below oxygen-nitrogen mixtures shows that the probability of attack *diminishes* and the conditional velocity of corrosion *increases* with oxygen concentration. This confirms the opinion of Schikorr (*Z. Elektrochem.*, 1933, 39, 409) that oxygen can be regarded as either a stimulator or inhibitor of corrosion.—J. S. G. T.

Rapid Method of Evaluating Corrosion. C. M. Chapman (*Refiner & Natural Gasoline Manuf.*, 1933, 12, 153-155; *J. Inst. Petrol. Tech.*, 1933, 19, 242A).—The exposure and examination of test-specimens inserted in closed vessels under operating conditions may be facilitated by the use of a corrosion tester, which represents a means of introducing and withdrawing specimens without interruption to plant operation. Specimens are attached to the end of a threaded spindle by means of which they are projected through a valve and connection into the vessel for exposure, and withdrawn for inspection by removal of the projecting spindle and yoke attachment from the valve. The exact type and size of the inserted specimens is limited by the diameter of the passage way through the valve and connection ($\frac{3}{4}$ in.) and to a length which allows clearance with the valve gate, about $1\frac{1}{2}$ in. A quick method for determining the relative suitability of metals for corrosion-resistance consists in polishing one or more exposure surfaces of a test-specimen to such a degree as to permit microscopic observation of corrosion. As a highly-polished surface tends to inhibit corrosion the final polish is made with No. 4/0 emery paper, which finish does not inhibit corrosion. In actual tests, specimens thus prepared were exposed to the action of corrosive water for 16 hrs., and the specimens, by microscopic examination, subsequently arranged in the order of resistance, which approximated to the valuation obtained by 2-year service tests.—S. G.

V.—PROTECTION

(Other than Electrodeposition.)

(Continued from pp. 387–389.)

Cinematographic Survey of Anodic Passivity Processes (with Film Production, and Discussion). W. J. Müller (*Z. Elektrochem.*, 1934, 40, 536).—Read before the Deutsche Bunsen Gesellschaft. A note of an exposition of the phenomenon of passivity of different metals by means of an ordinary cinematograph camera. In the discussion, the passivity of aluminium is described, and it is stated that ferrous sulphate can form a primary film without the presence of a trace of ferric sulphate.—J. H. W.

***Plating of Light Alloys by the Method of Dipping in Fused Salts.** K. P. Lebedev and T. K. Riazhskaia (*Trudi Nauchno-Issledovatel'skogo Instituta Legkih Metallov*—"NIISALUMINI" (*Transactions of the Scientific Research Institute for Light Metals*—"NIISALUMINI"), 1932, (1–2), 82–86).—[In Russian.] Metal coatings were obtained by dipping aluminium, Duralumin, and Elektron in molten salts of zinc, copper, nickel, cadmium, and chromium. The best results for aluminium and its alloys were obtained by coating it with zinc in a mixture of the chlorides of zinc 75, potassium 12.5, and sodium 12.5% at 425° C. for 3–5 minutes. Copper-plating was unsatisfactory, whilst the other metals require further experiments.—D. N. S.

***Cementation with Aluminium in Works Practice.** V. O. Gess (*Vestnik Metallopromishlennosti (Messenger of the Metal Industry)*, 1933, (4), 31–35).—[In Russian.] For the aluminium coating of iron case-hardening boxes the boxes are pickled in sulphuric acid, washed with alkali solution, dried, and coated internally with graphite paint. Aluminium or Lantal is melted in a graphite crucible, 6–8% of iron shavings added, and the boxes submerged in the metal at 790°–800° C. for 40–50 minutes. They are then coated with sodium silicate solution and annealed at 950°–1000° C. for 2 hrs.—D. N. S.

***Hot-Dipped Aluminium Coatings on Iron.** H. Röhrig (*Z. Metallkunde*, 1934, 26, 87–90; and (translation) *Aluminium Broadcast*, 1934, 4, (29), 1–7).—Hot-dipped aluminium coatings on iron consist of three layers: (A) the iron-aluminium solid solution immediately above the iron core, (B) a brittle intermediate zone of FeAl₃, and (C) an outer surface of aluminium penetrated with FeAl₃ crystals. The increase in the thickness of B is greater with rise in temperature than with an increased time of immersion. The total thickness of the deposit increases rapidly with rise in temperature and time of immersion. The aluminium grips the iron by penetration into those constituents for which it has the greatest affinity. Addition of silicon to the aluminium bath reduces the thickness of the FeAl₃ layer by up to 50%. Before immersion in the aluminium the iron should be pickled in a salt-bath, preferably after being coated with a non-hygroscopic film of zinc ammonium chloride. Methods of testing aluminium-coated wires are described; they are similar to those used for zinc-coated wires.—B. Bl.

***Preece Test (Copper Sulphate Dip) for Zinc Coatings.** E. C. Groesbeck and H. H. Walkup (*U.S. Bur. Stand. J. Research*, 1934, 12, 785–802; *Research Paper No. 688*).—The Preece test is in common use for inspection purposes to determine the uniformity of galvanized coatings, even though the results are sometimes erratic. An experimental study made with wires with different types of zinc coating and with wires consisting of commercially pure zinc and iron indicates that the p_H value of the copper sulphate solution, the rate of solution of the zinc coating, and the cleanness of the test specimens are important factors in the Preece test. The use of cupric hydroxide instead of cupric oxide for neutralizing the copper sulphate solution is recommended, since a stable p_H is much more quickly reached by its use. Electroplated and

sprayed zinc coatings dissolve more rapidly in the copper sulphate solution than do hot-dipped or galvanized coatings. Pure zinc coatings showed, during their solution, a "potential minimum" (with respect to a copper wire) which was practically absent with coatings that contain iron, such as on galvanized wires and the inner layer of hot-dipped galvanized wires. This minimum may be caused by the delayed coagulation of basic zinc compounds, which coagulation may be accelerated by the presence of iron. The causes and remedies of premature and delayed end-points are explained. A method for measuring the thickness-distribution of the zinc-coating by the use of a suitably acidified copper sulphate solution is suggested.—S. G.

Corrosion of Oil Well Tubing [Use of Galvanized Tubing]. W. F. Rogers (*Oil and Gas J.*, 1933, 32, (1), 61; *J. Inst. Petrol. Tech.*, 1933, 19, 259A).—From records of a large number of tube failures the results show that the most common occur in the joint ends either from corrosion at the back of the threads, thread breaks, or split joints. Corrosion of the joints is a particularly bad form of attack. Where severe corrosive conditions prevail the use of galvanized external upset seamless steel tubing is advocated.—S. G.

Combating Rust with Metallic Finishes. H. Chace (*Synthetic and Applied Finishes*, 1933, 4, (37), 3; *Res. Assoc. Brit. Paint. Manuf. Rev.*, 1933, (33), 143).—Samples of steel coated with metallic finishes and exposed to external weathering in New York have been weighed every 2 months. Cadmium coatings weathered at twice the rate of zinc coatings. In these conditions salt-spray tests showed zinc coatings to be much inferior. Nickel and Monel metal failed in less than 2 months, sprayed lead was better, but not so good as sprayed aluminium. Hot-dipped lead coatings show no sign of pinhole corrosion.—S. G.

Resisting Corrosion. J. Winning (*Mech. World*, 1934, 95, 599).—A letter to the Editor advocating cadmium plating as a protection for iron and steel and enumerating some of its advantages.—F. J.

Rapid Testing of the Characteristics of Metallic Coatings. Alexander Glazunov (*Iron Age*, 1934, 134, (1), 12-14).—A known length of wire, coated with metal is exposed to electrolytic action under given conditions. If e = the electro-chemical equivalent of the metal, A = the current intensity in amperes, t = the time in seconds, s = the specific gravity, l = the length of the wire exposed, and r = its radius in cm., then the thickness of the surface layer, $d = \frac{e \times A \times t}{s \times l \times 2\pi r}$ cm.—J. H. W.

Metal Spraying in the Petroleum and Natural Gas Industries. H. B. Rice (*Refiner & Natural Gasoline Manuf.*, 1933, 12, 148-152).—S. G.

Lacquering Cast Aluminium. H. Gge (*Indust.-Lackier-Betrieb*, 1933, (5), 59; *Res. Assoc. Brit. Paint Manuf. Rev.*, 1933, (32), 89).—Cheap cast aluminium articles may be lacquered satisfactorily if they are first boiled in caustic soda for a short time in order to form a "passive" layer of aluminate. They should then be well washed and dried, when, if they show a grey appearance, they should be further treated with nitric acid and very carefully washed and dried. Costly articles should be dipped in solutions to give a metallic undercoat (of brass or pure copper or zinc).—S. G.

[Protection of Cans for] Canning Fruit and Vegetables. G. Cadbury (*Synthetic and Applied Finishes*, 1934, 4, 302; *Res. Assoc. Brit. Paint Manuf. Rev.*, 1934, (37), 18).—Tins for fruit should be coated internally with a double layer of varnish; a single layer is less effective than no varnish since rapid corrosion occurs at any cracks in the coating. For vegetable tins a special sulphur-resisting varnish containing zinc is used.—S. G.

Varnishes and Temperatures for Tin Containers. Anon. (*Mod. Lith. and Offset Printer*, 1933, 29, 186; *Res. Assoc. Brit. Paint Manuf. Rev.*, 1933, (36), 308).—Lacquers for food containers must be formulated with special regard to

the conditions to which they are subjected. It is essential that the temperature of baking ovens be carefully regulated. A device for measuring the temperature of tinplate at various points in an oven is described.—S. G.

Rust-Proofing of Tinned Objects. F. Hth (*Indust.-Lackier-Betrieb*, 1933, (27), 319; *Res. Assoc. Brit. Paint Manuf. Rev.*, 1934, (38), 152).—A thick tin coating is essential; where thin spots occur exposure to a flame may cause melting of tin or exposure of the iron. This can be avoided by coating the tin surface with a "bronze"; for the latter any heat-resistant varnish or lacquer may be used, e.g. one containing cellulose acetate or bitumen. For storm lanterns aluminium-bronze is best, as copper and brass are liable to discoloration.—S. G.

Varnishing of Galvanized Iron Objects. F. Hth (*Indust.-Lackier-Betrieb*, 1933, (27), 320; *Res. Assoc. Brit. Paint Manuf. Rev.*, 1934, (38), 98).—A composition is used containing copal or synthetic resin with 0.6–1% formic or butyric acid, which removes any trace of oxide from the surface. Owing to crystallization, the zinc surface is sufficiently rough to hold the varnish.—S. G.

Anti-Rust Preparations. S. Salm (*Allgem. Oel u. Fett Zeit.*, 1933, 30, 87–88; *Res. Assoc. Brit. Paint Manuf. Rev.*, 1933, (32), 88).—Lanoline or vaseline containing 10% lanoline, dissolved in solvent such as white spirit, are useful preparations. Schürer recommends the following: for metal articles, 125 gm. lard melted with 20 gm. camphor to which graphite is added. For nickel articles, 50 kg. stearin oil are stirred with sal ammoniac and 250 gm. benzene and 375 gm. vinegar added.—S. G.

Painting on Aluminium and Aluminium Alloys. — Eckert (*Angew. Chem.*, 1933, 46, 784; *Res. Assoc. Brit. Paint Manuf. Rev.*, 1934, (37), 14).—Preliminary roughening and removal of grease are important for adherence in the painting of aluminium. With otherwise faultless painting adherence often may be greatly decreased by the formation of pores, possibly submicroscopic. Correct choice of pigment and correct amount of dilute avoid this. Aromatic compounds permit of better adsorption than aliphatic. Basic pigments are suitable, but cannot be worked with every binder. Very finely ground aluminium is an excellent pigment. The synthetic resins from phthalic acid and from formaldehyde have a good adherence, hardness and elasticity, only 1 coat is required, no roughening and no priming, but the technical advantage of this valuable stoving varnish is decreased by the high baking temperature (150°–180°), which promotes intercrystalline corrosion and spoils the adherence properties. For all these alloys a 5-hr. baking at 200° is the maximum possible.—S. G.

Painting Aluminium Alloys. Anon. (*Indust.-Lackier-Betrieb*, 1933, (12), 144; *Res. Assoc. Brit. Paint Manuf. Rev.*, 1933, (34), 213).—All parts of aircraft motors were coated with Japan or enamel before assembly. A black japan was sprayed on to the cylinders and a grey enamel on to the other parts. In the Wright factory (U.S.A.) the cylinders were put into a 2-chambered furnace and brought to a temperature of 233°; other parts were heated in an electric furnace to 121°.—S. G.

Surface Preparation and Corrosion-Resistance of Aluminium. Anon. (*Indust.-Lackier-Betrieb*, 1934, (1/2), 12; *Res. Assoc. Brit. Paint Manuf. Rev.*, 1934, (38), 151).—For paint to adhere, the surface should be made passive by anodic oxidation. A suitable priming coat is given by $ZnCrO_4$ or aluminium in oil. Various electrolytes are used, e.g. chromic, sulphuric, and oxalic acids. Flawless surfaces result from anodic treatment of aluminium-silicon, zinc-copper, and copper-aluminium alloys. Oil or wax is used for final treatment. After treatment with sulphuric or oxalic acid the resulting coatings are mechanically and chemically highly resistant.—S. G.

VI.—ELECTRODEPOSITION

(Continued from p. 389.)

***Electrolytic Deposition of Aluminium From a Molten Medium.** V. Plotnikov, N. Gratsiansky, and Z. Demtshenko (*Legkie Metalli (Light Metals)*, 1933, (2-3), 27-31).—[In Russian.] Good deposits of aluminium on copper can be obtained from a 3 : 2 molecular mixture of aluminium and sodium chlorides; for iron a 2 : 1 mixture is better. The optimum temperature is 200°-250° C. and current density 1 amp./dm.².—D. N. S.

The Theory of Chromium Plating. Erich Müller (*Z. Elektrochem.*, 1934, 40, 344-352).—Cf. *Met. Abs.*, this volume, pp. 352-353. The explanation of M.'s theory of chromium plating is concluded.—J. H. W.

***Rapid Electrographic Differentiation of Chromium-Plated and Nickel-Plated Goods.** Alexander Glazunov and J. Křivohlavý (*Chem. Obzor*, 1933, 8, 175-177).—A spot test and an electrographic method of identifying electrodeposits on metals are described. For nickel an acetic acid alcoholic solution of dimethylglyoxime is used, and for chromium a sulphuric acid solution of diphenylcarbazide.—R. P.

Gold Electroplating. Paul A. Oldam (*Monthly Rev. Amer. Electroplaters' Soc.*, 1934, 20, (10), 27-34).—Notes on the preparation, operation, and control of gold-plating solutions, especially those used for the deposition of alloy deposits of various colours.—A. R. P.

Recent Developments in the Electrodeposition of Nickel. A. W. Hother-sall (*Met. Ind. (Lond.)*, 1934, 45, 109-121, 157-159).—Reproduced from a booklet issued by the Mond Nickel Co., Ltd.—J. H. W.

Peeling of Nickel-Chromium Deposits. André Darlay (*Galvano*, 1934, (25), 17-20).—Faults in degreasing and in the electroplating process, which lead to subsequent peeling, are discussed.—E. S. H.

***On the Question of the Electrodeposition of Iron-Nickel Alloys.** F. Marchak, D. Stepanow, and C. Beljakowa (*Z. Elektrochem.*, 1934, 40, 341-344).—The electrodeposition of iron and nickel from a mixture of the solutions of the simple salts in the presence of colloids and conducting salts has been investigated and the simultaneous deposition of iron and nickel on the cathode has been obtained. These deposits have a quite uniform and fine crystalline structure, and adhere strongly to the base; when thin they are elastic. From the earlier investigations it appears that the nickel content of the deposit increases with longer periods of electrolysis of solutions which have lower nickel concentrations and decreases in the course of time with electrolytes having higher concentrations of nickel.—J. H. W.

Electrolytic Deposits of Rhodium. J. Milinaire (*Galvano*, 1934, (25), 23-24).—A brief discussion of recent developments and applications.—E. S. H.

Notes on Cyanide Solutions [Silver Plating Baths]. Richard M. Wick (*Monthly Rev. Amer. Electroplaters' Soc.*, 1934, 20, (10), 10-15; discussion, 15-16).—Decomposition of cyanide plating baths proceeds chiefly by hydrolysis and oxidation. At room temperature hydrolysis produces hydrocyanic acid, which is partly lost by evaporation, and alkali hydroxide, which is slowly converted into carbonate; at higher temperatures, especially above 45° C., alkali formate is formed, which may be anodically oxidized to alkali carbonate. At high current densities cyanate is formed at the anode, and this may be hydrolyzed to carbonate and ammonia, the latter then forming urea with unchanged cyanate. Since the presence of argenticyanide in cyanide solution restrains loss of hydrocyanic acid when air is bubbled through, it is probable that more complex compounds than $KAg(CN)_2$ are present in silver plating baths.—A. R. P.

***Examination of Electrolytic Silver Deposits by X-Rays.** G. R. Levi and M. Tabet (*Atti R. Accad. Lincei (Roma)*, 1934, 18, 463-467; *C. Abs.*, 1934, 28, 3003).—Bright deposits of silver were examined. The silver is deposited in isodiametric particles, whereas chromium is deposited as plates (*Met. Abs.*, this volume, p. 299). This is proof that plate structure is not a necessary condition for producing bright deposits.—S. G.

Acid Tin Plating. P. R. Pines (*Monthly Rev. Amer. Electroplaters' Soc.*, 1934, 20, (10), 49-52).—A sulphate bath containing free sulphuric acid 6-8 and stannous sulphate 6 oz./gall., together with certain addition agents (nature not stated), gives bright adherent tin deposits with nearly 100% current efficiency when operated at 25°-30° C. with 5-50 amp./ft.² and gentle agitation. At 40 amp./ft.² a thickness of 0.001 in. is deposited as a bright silver-white plate in 11½ minutes. The throwing power is in excess of 200% on Pan's cavity scale.—A. R. P.

***The Throwing Power of Zinc Plating Solutions. II.—The Relation Between Current Density and Cathodic Polarization Potential of Zinc Sulphate Solutions.** Masami Nakajima (*J. Electrochem. Assoc. (Japan)*, 1934, 2, 72-75; *C. Abs.*, 1934, 28, 3307).—[In Japanese.] Cf. *Met. Abs.*, this volume, p. 309. The relation between current density and cathodic polarization potential has been worked out with 0.5-2.5-N zinc sulphate solution (p_H 3.4-1.6). The polarization potential is increased with an increase in current density and is decreased with an increase in zinc sulphate concentration. In a zinc sulphate solution of the same concentration, this potential tends to be increased with a decrease in p_H value, and the lowest potential has been attained in 0.5 and 1.5-N solutions with p_H 2.8, and in 2.5-N solution with p_H 3.4 at lower current density and with p_H 2.2 at higher current density. Change in p_H does not greatly affect the polarization; the greatest effect is observed in 0.5-N concentration; it decreases with an increasing zinc sulphate concentration.—S. G.

***On the Structure of a Cathodic Deposit.** A. Glazunov (*Z. physikal. Chem.*, 1934, [A], 167, 399-406).—A very elegant apparatus is described for following under the microscope the course of crystallization in the cathodic deposition of metals; the number of nuclei (KZ) and the rate of crystallization parallel (KG₁) and perpendicular (KG₂) to the lines of current increase with rise in current density. KG₁ and KZ decrease with increasing concentration of electrolyte, whilst KG₂ increases. The nature of the deposit (dense or powdery) depends on the ratio KG₂:KZ; if KG₂ is small and KZ large the deposit is powdery, and if KG₂:KZ is large a smooth mirror-like deposit is obtained. A high value of KG₁ produces a dendritic deposit with a rough surface.—B. B.

Protective Value of Plated Coatings on Non-Ferrous Metals [with Interpolated Discussion]. Wm. Blum (*Monthly Rev. Amer. Electroplaters' Soc.*, 1934, 21, (1), 14-23).—A progress report and discussion of research on plated coatings now being carried out by the A.E.S. Most of the discussion is concerned with the value of a sodium nitrate stripping bath for removing nickel plate from steel by anodic treatment. The bath is unsuitable for high-carbon steel, and occasionally causes pitting or serious corrosion of low-carbon steel the reason for which is still obscure.—A. R. P.

†**What is Under the Plate.** George B. Hogaboom (*Monthly Rev. Amer. Electroplaters' Soc.*, 1934, 21, (1), 5-13).—The importance of correct treatment, especially as regards cleaning and polishing, of the base metal prior to electroplating is stressed, and recent work on the subject is critically reviewed.

—A. R. P.

Some Further Electrochemical Principles Applied in Electrodeposition.

I.—Secondary Electrodes. Samuel Field (*Met. Ind. (Lond.)*, 1934, 45, 61-63).—The use of copper and lead as secondary electrodes and the mechanism of the process are described.—J. H. W.

VII.—ELECTROMETALLURGY AND ELECTROCHEMISTRY

(Other than Electrodeposition and Electro-Refining.)

(Continued from pp. 354-355.)

*On Potentials in the Electrolytes of Foreign Ions. O. Essin and M. Lozmanova (*Z. physikal. Chem.*, 1934, [A], **167**, 209-220).—The potentials of gold in copper sulphate, copper nitrate, and silver nitrate solutions have been measured and compared with those of copper in copper sulphate and nitrate, and of silver in silver nitrate solutions. The gold potential is in all cases a linear function of the potential of the metal that forms the cation of the electrolyte: $E_{\text{Au/MeX}} = a + b \cdot E_{\text{Me/MeX}}$. In addition, there is a logarithmic relation to the activity of the cation of the electrolyte. The results can be explained by adsorption phenomena.—B. Bl.

*The Electrolytic Potential of Nickel. L. Colombier (*Compt. rend.*, 1934, **199**, 273-275).—The electrolytic potential of nickel in 3 forms: massive (small cubes cut from a commercial plate), electrolytic (deposited at high current density), and reduced (by hydrogen), has been determined in a normal solution of pure nickel sulphate. The potentials were measured with calomel electrodes and calculated for the normal hydrogen electrode. The value found for the potential under these conditions was: $E_h = -0.227 \pm 0.002$ volt at 20° C.

—J. H. W.

Mechanical Activation of Electrode Surface. K. M. Gorbunova and A. T. Vagramyan (*Dokladii Akademii Nauk, U.R.S.S. (Compt. rend. acad. sci., U.R.S.S.)*, 1934, [N.S.], **1**, 127-128 (in Russian); 128-129 (in French); *C. Abs.*, 1934, **28**, 3666).—A silver cathode submerged into 3-N silver nitrate solution remains passive at polarization up to 0.6×10^{-2} v. Increase of polarization up to 1.7×10^{-2} v. results in the formation of microscopic crystals which are capable of growth at lower potentials. A scratch made on the surface of the electrode enables crystals to form at much lower potentials. Scratching increases the number of active places due to freeing of microcrystalline surfaces where localized separation of metal takes place.—S. G.

*Antimony Electrodes. Arvid Holmquist (*Svensk Kem. Tids.*, 1934, **46**, 2-10; *C. Abs.*, 1934, **28**, 3005).—The potentials of antimony rods are very different from antimony powder and these electrodes in HBr or HCl are not like those in H_2SO_4 or HClO_4 . Plotting p_H against acid concentration gives different types of curves. There are tables giving oxidation-reduction potentials for Sb^{III} and Sb^{IV} , also partition data for SbCl_3 in $\text{H}_2\text{O}|\text{Et}_2\text{O}$.—S. G.

*Rate of Crystallization in the Electrolysis of Cadmium Acetate and Nitrate. [Electrolysis Under the Microscope.—VI.] Alexander Glazunov and B. Koufil (*Chem. Listy*, 1933, **27**, 489-493).—Numerous figures are given for the rate of crystallization of electrolytic cadmium deposits from nitrate and acetate baths. Photomicrographs are given showing characteristic structures obtained at various current densities and at various concentrations of the electrolyte.

—R. P.

*The Number of Crystallization Centres in the Electrolysis of Copper from Copper Sulphate Solutions. [Electrolysis Under the Microscope.—VII.] Alexander Glazunov and J. Janousek (*Chem. Listy*, 1933, **27**, 457-461).—The cathodic deposition of copper has been studied photomicrographically, and the number of crystallization centres has been determined from electrolytes of various concentrations and at various current densities. High current densities increase the number of centres, but high concentration of the electrolyte reduces the number and results in a dense cathodic deposit.—R. P.

IX.—ANALYSIS

(Continued from pp. 389-391.)

New British Chemical Standard Aluminium-Silicon Alloy "B." — (*Met. Ind. (Lond.)*, 1934, 45, 87).—Aluminium-silicon alloy "B" contains: silicon 12.74, iron 0.34, manganese 0.005, zinc 0.020, titanium 0.006, copper 0.010%, and is believed to be the only standard of its kind issued in Great Britain, U.S.A., or the Continent.—J. H. W.

***Parting Loss in the Gold Assay.** August Hackl (*Z. anal. Chem.*, 1934, 97, 411-415).—In the parting assay of Au errors of up to 0.2% may arise due to solubility of the Au in the parting HNO_3 . These errors may be avoided by addition of 0.1 vol.-% of CH_3OH to the acid or by the use of Cd (5 times the weight of the Au) for inquarteration instead of Ag.—A. R. P.

***The Volumetric Assay of Gold.** W. Branch Pollard (*Trans. Inst. Min. Met.*, 1932, 41, 434-454; disc., 454-457).—See *J. Inst. Metals*, 1932, 50, 365.—S. G.

***Technique of Amalgam Assaying of Platinum.** I. N. Plaksin and S. M. Shtamova (*Izvestia Platinago Instituta (Annales de l'Institut de Platine)*, 1933, (11), 141-157).—[In Russian.] To prepare successfully an amalgam of native platinum containing iron the superficial film of iron oxide must first be removed by agitating the metal in 0.37-0.63% sulphuric acid for 12 hrs., and then setting the mixture aside for 1-2 days. From 90 to 97.1% of the platinum is amalgamated.—N. A.

The Polarograph: A Valuable Tool in Quantitative Chemical Analysis. John Herman (*Eng. & Min. J.*, 1934, 135, (7), 299-300).—Describes an analytical instrument working on the basis of the difference in decomposition voltage of chemical compounds, and the direct relations between electrical effect and the concentration of a compound in a solution. Can be used for detection of impurities and stated to have a sensitivity of 1 p.p.m.—R. Gr.

***On Colour Reactions of the Rare-Earths with Pyrogallol, Cerium Reactions with Pyrogallol, and Reactions of Thorium, Lanthanum, and Elements of the Third Analytical Group with Pyrogallol.** F. M. Schemjakin (*Z. anorg. Chem.*, 1934, 217, 272-276).—With NH_4OH and 1% pyrogallol solution, Fe^{+++} gives brown hydroxide flocks, Cr^{+++} green $\text{Cr}(\text{OH})_3$, K_2CrO_4 a reddish-brown solution, $(\text{CH}_3\text{CO}_2)_2\text{UO}_2$, Al^{+++} , Mn^{++} , Ni^{++} , Zn^{++} a brownish solution. Co^{++} a lilac brown solution which becomes darker on keeping, TiO_2 an ochre brown precipitate stable on boiling or keeping, and Ce^{+++} and Ce^{IV} a characteristic blue precipitate.—B. Bl.

***A New Method for the Separation of Lead from Zinc and Their Subsequent Estimations.** Kishori Mohan Sil (*J. Indian Chem. Soc.*, 1933, 10, 137-141).—A quantitative precipitation of lead is given by H_2O_2 and NH_4OH . The precipitate, a mixture of PbO and PbO_2 varying according to the concentration of NH_4NO_3 , when heated gently or in a "crucible bath," gives a residue of pure PbO . Zinc is not precipitated, and can be estimated by the usual method.—R. G.

***Separation of Nickel and Cobalt by Means of Alkaline Phosphates.** H. Wunschendorff and (Mme.) P. Valier (*Bull. Soc. chim. France*, 1934, (v), 1, 85-90).—In solutions of p_{H} 5.5 buffered with a mixture of alkali phosphates neutral solutions of Co salts give a blue precipitate, whereas Ni solutions give no precipitate. The test is carried out at 100° C. by adding the Co-Ni solution drop by drop to the phosphate solution.—A. R. P.

***Contributions to the Potentiometric Determination of Ions of Heavy Metals with Sodium Sulphide.** W. Hiltner and W. Grundmann (*Z. physikal. Chem.*, 1934, [A], 163, 291-307).—By titrating rapidly with 0.1N- Na_2S solution using a tube potentiometer and a Ag_2SO_4 electrode, Ag can be determined in the presence of Cu and Cd, Cu and Pb, and of Cu and Zn; Cd can be similarly deter-

mined in the presence of Zn. The heavy metal sulphides do not form solid solutions with one another, but precipitate one after the other. Bi, Pb, Ni, Co, Mn, Sb, and As cannot be determined by this method, since either the rate of formation of the sulphides is too small or the adsorption of sulphide ions is too great.—B. Bl.

***A New Method of Determining Aluminium Oxide in Aluminium and Its Alloys.** J. Kliachko (*Legkie Metalli (Light Metals)*, 1933, (9), 44).—[In Russian.] The powdered metal (3 grm.) is dissolved in 50 c.c. of H₂O and 120–150 c.c. of saturated CuCl₂ solution, 25 c.c. of HNO₃ (1 : 5) are added, the insoluble Fe₂O₃, Al₂O₃, and SiO₂ are collected, the SiO₂ is volatilized with HF, and the residue fused with K₂S₂O₈. In the aqueous solution of the melt the H is removed with NaOH solution and the Al is recovered from the filtrate in the usual way.—D. N. S.

***An Indirect Method for the Potentiometric Determination of Cadmium.** G. Spacu and P. Spacu (*Z. anal. Chem.*, 1934, 97, 263–266).—The Cd is precipitated with an excess of standard KCNS in the presence of C₆H₅N, and after filtering off the crystals of Cd(C₆H₅N)₂(SCN)₂ the excess of KCNS is titrated with AgNO₃.—A. R. P.

***Volumetric Determination of Cerium by the Aid of Induced Oxidation of Cerous Salts by Chromic and Arsenious Acids.** Rudolf Lang (*Z. anal. Chem.*, 1934, 97, 395–401).—The solution containing all the Ce as Ce⁺⁺⁺ is acidified with 5–30 c.c. of HCl, HNO₃, or H₂SO₄ per 200 c.c., treated with 4–5 grm. of HPO₃ and 3 drops of diphenylamine solution (1 grm. in 100 c.c. of syrupy H₃PO₄), then with 30 c.c. of K₂Cr₂O₇ solution (15 grm./litre) and 35–40 c.c. of As₂O₃ solution (15 grm. of As₂O₃ and 10 grm. of NaHCO₃/litre), shaken for ½ minute, and titrated with 0.1N-FeSO₄ solution until the blue colour becomes grass-green.—A. R. P.

Volumetric Estimation of Copper. Erich Boye (*Ber. deut. chem. Ges.*, 1934, [B], 67, (66), 1119–1121).—Thiocyanate estimation methods are reviewed. A criticism by Henriques of Volhard's methods is followed by a summary of Theodor's procedure of back-titrating excess of thiocyanate in faintly acid solution with AgNO₃. B. suggests heating the cupric water-alcohol solution almost to boiling with hydroxylamine sulphate in a stream of N₂ or CO₂, and titrating direct with AgNO₃. Suitable concentrations and detailed directions are given. Concordant results, closely approaching theoretical values, are claimed for many copper salts.—P. R.

***Quantitative Spectrographic Analysis of Metals in Small Proportions in Light Alloys. A New Method of Determining Magnesium in Aluminium and Duralumin.** Henri Triché (*Bull. Soc. chim. France*, 1934, (v), 1, 495–505).—The method described gives the Mg content of Al and Duralumin with an error of ± 10%, but is much more rapid than chemical analysis. The original must be consulted for details.—A. R. P.

The Volumetric Determination of Tin. Use of Potassium Iodate. J. B. Ramsey and J. G. Blann (*J. Amer. Chem. Soc.*, 1934, 56, 815–818).—Determination of Sn by direct titration of air-free stannous solution with KIO₃ was found to give uniform results over a range of acid concentration up to 1.5–2.0N, and to be therefore superior to the use of I₂ in KI solution. The effect of the presence of other elements is shown.—R. G.

Determination of Small Quantities of Zinc with Dithizone. Hellmut Fischer and Grete Leopoldi (*Z. anal. Chem.*, 1934, 97, 385–395).—The method proposed by Rienacker and Schiff (*ibid.*, 1933, 94, 409–415) is subject to many sources of error. F. and L. recommend that Cu, Hg, Ag, Au, and Pt be first removed by boiling with H₃PO₃, and that the dithizone test for Zn be then made in a well-buffered acetate solution. Details of the recommended procedure are given in the paper.—A. R. P.

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

(Continued from pp. 392-394.)

Engineering Problems in Aviation. Alexander Stoneman (*J. Inst. Eng. Australia*, 1933, 5, 368-377).—A review of S.'s experience. Inspection methods for detecting cracks in aluminium alloy pistons consisted of either pickling in caustic soda, and then in nitric acid or in dipping in hot kerosene containing a little oil, wiping dry, and covering with French chalk to show seepage of oil from any cracks.—R. G.

A Mechanical Testing Machine. R. C. Gale (*J. Sci. Instruments*, 1934, 11, 209-214).—Describes a small mechanical testing machine suitable for industrial, experimental, and educational work. The machine is of the horizontal type, and the stress is applied by the rotation of a capstan-headed screw, and is balanced by the compression of a stiff helical spring, the load being read on a dial gauge reading up to 600 or 1200 lb. By means of suitable holders, which are described and illustrated, the machine can be used for tensile, compression, bending, indentation, and cupping tests.—W. H.-R.

Metal Fatigue and Methods for Its Measurement. R. Cazaud (*J. Aeronaut. Sci.*, 1934, 1, 137-143).—An illustrated account is given of some typical fatigue failures, and the rotating flexure test, described in detail, is recommended as a standard method of determining fatigue strength. Results of this test are tabulated for a series of steels and for the following non-ferrous alloys: sand-cast and die-cast aluminium-copper (8 and 12% copper, respectively), die-cast aluminium-silicon (silicon, 5, 12, and 18%), drawn and heat-treated Duralumin, drawn magnesium-aluminium (aluminium 6%), drawn magnesium-aluminium-copper (aluminium 9, copper 3%). Types of test-piece for initial and inspection tests are illustrated, and the influence of holes, threading, and abrupt alterations in cross-section is discussed.—P. M. C. R.

†Bendability. W. Burggaller (*Draht-Well*, 1934, 27, 195-197, 211-213).—A critical discussion of to-and-fro bending tests embodying the findings of Sachs and Sieglerschmidt, Schuchard, and Herbst, as well as results from B.'s own dissertation. It was found that logarithmic plotting of bending number B_Z and bending grade $B_G = \frac{2R}{d} + 1.65 + 0.05d$, where R is the mandrel radius and d the wire diameter (both in mm.), gave straight lines of uniform slope of 2 for different materials. Thus $B_Z \propto B_G^2$. The bendability B_F is defined as the

bending number for $B_G = \sqrt{10}$, so that it can be derived from $B_F = 10 \frac{B_Z}{B_G^2}$.

Tables exemplifying these relations are given as well as a nomogram for determining the bendability from bending number, mandril radius, and wire diameter.—A. B. W.

Ductility Testing. Anon. (*Met. Ind. (Lond.)*, 1934, 45, 99-100).—A description is given of the Olsen cupping machine, in which the depth of the cup at fracture, the maximum load required, and also the depth of the cup and the corresponding load applied at any time during the progress of the test are registered.—J. H. W.

Elasticity Tests. G. Colonnati and G. M. Pugno (*Atti Pont. Accad. Sci. Nuovo Lincei*, 1931, 84, 525-530; *Sci. Abs.*, 1932, [A], 35, 5).—Points out a source of systematic error in the use of testing machines. The elasticity of constructional materials does not work out at the same values when the tests are taken with increasing weights as with decreasing weights.—S. G.

Standard Methods of Tension Testing of Metallic Materials (E 8-33). — (*Amer. Soc. Test. Mat. Standards*, 1933, (I), 949-964).—S. G.

Standard Method of Test for Thermoelectric Power of Electrical Resistance Alloys (B 77-33). — (*Amer. Soc. Test. Mat. Standards*, 1933, (I), 895-897).

—This method is intended for testing the thermoelectric power of a metal with respect to copper when the temperatures of the junctions lie between 0° and 100° C.—S. G.

XII.—TEMPERATURE MEASUREMENT AND CONTROL

(Continued from p. 363.)

A Connector for Wires—Particularly for the Cold-Junctions of Thermocouple Wires. R. J. M. Payne (*J. Sci. Instruments*, 1934, 11, 231-232).—Describes a split screw brass connector. When used for the cold-junction of a thermocouple the copper lead is soldered to the connector, which is screwed up so that the thermocouple wire is pinched tightly. In this way the thermocouple wires can be unscrewed for threading through apparatus.—W. H.-R.

A Precision Couple for Measuring Gas Temperatures. E. E. O. Mattock (*Metal Progress*, 1934, 26, (1), 37-40).—Working ranges and most favourable atmospheres are tabulated for copper-Constantan, iron-Constantan, Chromel-Alumel, Chromel-X-Copel, and platinum/platinum-rhodium couples. Errors arise mainly from the variety of methods by which heat is transmitted to the point of measurement. In gas thermometry, an equilibrium reading is often taken as the true temperature. Radiation errors and their correction are discussed, the method adopted by the American Gas Association being described in detail.—P. M. C. R.

***Response of Thermocouples.** N. P. Bailey (*Mech. Eng.*, 1931, 53, 797-804; *Sci. Abs.*, 1932, [B], 35, 121).—An account of research on effects of temperature gradients in the hot-junction, effects of varying temperatures on the indications of a thermocouple, and methods for predicting the performance of any couple of cylindrical form. The seat of the thermo-e.m.f. of a couple is the surface of contact, and 3 types of temperature gradient are possible: along the surface, normal to it, and across it. Each was studied separately. General conclusions include the fact that only the temperature of the contact surfaces affects the developed e.m.f., and that in a long junction it is the temperature (or temperatures) at the point of separation which is involved. Various experiments on the lag of couple e.m.f.'s behind a change of temperature, together with theoretical investigations, lead to a series of curves showing for a given diameter of wires forming the couple the lag due to various rates of change of ambient temperature. Curves and oscillograms illustrate the experimental results.—S. G.

***Establishment of a Scale of Colour Temperature.** H. D. Wensel, D. B. Judd, and Wm. F. Roeser (*U.S. Bur. Stand. J. Research*, 1934, 12, 527-536; *Research Paper No. 677*). A number of 400-watt projection lamps were colour matched with black bodies immersed in freezing platinum, rhodium, and iridium. From these lamps working standards of colour temperature were prepared, interpolation between the 3 fundamental points being accomplished by making use of the systematic difference between the colour temperature of the lamp and the brightness temperature of the inside of a particular turn of the coiled tungsten filament. These working standards embody a reproducible scale of colour temperature which is consistent with the International Temperature Scale within 5° K. everywhere in the range from 2000° to 2800° K. The new scale assigns higher values to any given source than the scale previously used at the Bureau of Standards, and which was supposed to be the same as the Nela scale of colour temperature. The differences are 22° K. at the platinum point and 14° K. at the rhodium and iridium points.—S. G.

XIII.—FOUNDRY PRACTICE AND APPLIANCES

(Continued from pp. 394-395.)

The Practice of Art Casting. Erich Becker (*Z. ges. Giesserei-Praxis: Das Metall*, 1934, 55, 307-309).—The devices and methods used in moulding for the production of art castings are described.—J. H. W.

Aluminium and Special Alloys. M. Bocahut (*Rev. Fonderie moderne*, 1934, 28, 205-210, discussion, 210-211).—Read before the Association Amicale et Mutuelle de Fonderie. Commonly occurring defects in aluminium castings and the methods of obviating them, the choice of primary materials, sand-casting, and the melting and casting of aluminium alloys are described. The composition, properties, and details of casting alloys of aluminium and zinc, copper, silicon, magnesium, nickel, and iron are given.—J. H. W.

Properties of Metals Cast under Pressure. A. P. Gulyayev (*Vestnik Inzenerov i Technikov (Messenger of Engineers and Technologists)*, 1933, (8), 350-353).—[In Russian.] Casting under pressure gives castings which are insufficiently dense (large cavities and blowholes), but by taking suitable precautions (low pouring temperature, thin stream of liquid metal, convenient arrangement of cores, insertions and other obstacles in the path of the flowing metal) this porosity may be, if not entirely avoided, at least considerably reduced. The portions without cavities show a dense and extremely fine-grained structure. Yield-point and hardness are always greater in pressure castings than those produced by other methods, but usually the toughness is somewhat lower, especially Silumin and copper-aluminium alloys. The 12% copper-aluminium alloy used in aero-engine pistons has the best properties after pressure casting.—N. A.

***Hot Mechanical Treatment of Light Alloys (Investigation of Sand-Castings).** V. M. Aristov and N. I. Korneyev (*Nimash (Bulletin of the Scientific Research Institute of Machine-Building and Metal Treating)*, 1933, (6), 28-33).—[In Russian.] Aluminium alloy castings with clearly marked defects (e.g. continuous porosity, cavities, axial friability) are unsuitable for hot-working.—N. A.

***The Thermal Preparation of Silumin Alloys and the Technique of Such Alloy Production.** V. N. Verigin (*Trudi Nauchno Issledovatel'skogo Instituta Legkih Metallov—"NIISALUMINI"* (*Transactions of the Scientific Research Institute for Light Metals—"NIISALUMINI,"* 1933, (4), 39-54).—[In Russian.] The preparation of Silumin by fusing aluminium with an alloy of 20% silicon and 80% aluminium in a rocking Morgan crucible furnace heated by petroleum residues is described. The alloy was obtained by melting aluminium with silico-aluminium containing 70% silicon. The temperature conditions and nature of fluxes to be used have been elucidated.—D. N. S.

***The Effect of Chloride Fluxes on Aluminium Alloys.** Eiichirō Itami (*Tetsu-to-Hagane (J. Iron Steel Inst. Japan)*, 1931, 17, (12), 1288-1335; *Japanese J. Eng. Abs.*, 1934, (11), 56).—[In Japanese.] The effects of various chloride fluxes on the properties of aluminium alloys are described. To prevent the formation of pinholes in cast aluminium alloys, chloride fluxes must be added at about 750° C.; among the various chlorides, SiCl_4 , TiCl_4 , and ZnCl_2 are the most effective for the improvement of the mechanical properties of the alloys, but SnCl_4 has sometimes an adverse effect. The quantity to be added need not exceed 1%. The addition of SiCl_4 does not affect the composition of the alloys, but tin, titanium, and zinc are dissolved in the alloy from the chlorides, and the magnesium content of "Y" alloy and Duralumin is decreased by this treatment. The changes in microstructure are discussed.—S. G.

Difficulties in the Production of "Aluminium-Bronze" Castings. E. T. Richards (*Z. ges. Giesserei-Praxis: Das Metall*, 1934, 55, 265-267).—One of

the chief difficulties in casting "aluminium-bronze" is the change in structure that takes place during the long solidification interval. This can be obviated by casting the metal in iron moulds, by sand-casting and removing the casting as soon as it is solid, or by the addition of 3-4% iron or nickel. A casting temperature of 1200° C. and a mould temperature for iron moulds of 250° C. are recommended. Allowance must be made for the high shrinkage of the alloy.—J. H. W.

Bohn Solves Difficult Production Problems to get Quantity Output of Copper-Lead Bearings. A. F. Denham (*Automotive Ind.*, 1934, 71, (1), 14-16).—The development of copper-lead bearings demanded careful control of heating technique and solidification conditions, owing to the high casting temperature and great solidification range of the material, and to the need for securing a copper-iron bond with the casing. Conditions of production are discussed, and the advantages of copper-lead bearings are summarized.—P. M. C. R.

Elektron. E. Player (*J. Coventry Eng. Soc.*, 1933, 14, 59-67).—A lecture describing mainly the technique of casting the magnesium-base alloys known as Elektron. Castings are made in green sand, porous and low in clay content, containing sulphur and boric acid. Moulding practice follows ordinary lines, and the casting is preferably bottom run. Die-casting of the alloys has been developed. Various questions of interest are dealt with in the discussion of the lecture.—R. G.

***Melting of Magnesium Alloys.** P. S. Mayboroda (*Legkie Metalli (Light Metals)*, 1932, (10-11) 26-28).—[In Russian.] Experiments have been made to determine whether the use of fluxes in melting magnesium alloys serves not only to protect the metal from oxidation, but also to remove impurities by absorption. The results indicated that on mixing metal and flux the latter is occluded in the metal and causes cavities in the castings.—D. N. S.

Slush Casting Aluminium Spouts. E. Stevan (*Machinist (Eur. Edn.)*, 1934, 134, 410-411E).—The mould preparation and the method of slush casting aluminium kettle-spouts are described.—J. H. W.

Zinc-Base Pressure Die-Castings. Anon. (*Metallurgist (Suppt. to Engineer)*, 1934, 9, 119-120).—A summary and discussion of a paper by D. L. Colwell in *Metal Progress*, 1933, 24, (6), 19-23. See *Met. Abs.*, this volume, p. 98.—R. G.

Improved Technique Gives Die-Casting Process New Applications. Herbert Chase (*Automotive Ind.*, 1934, 71, (1), 18-20, 30).—The cost of dies for intricate castings is in many cases justified by the precision with which the work can be executed, obviating expensive machining and finishing. Some cases in point, notably of die-cast zinc alloys, are discussed and illustrated.—P. M. C. R.

***On the Properties of Moulding Sands at High Temperatures.** Tokushichi Mishima (*Tetsu-to-Hagane (J. Iron Steel Inst. Japan)*, 1929, 15, (11), 949-962; *Japanese J. Eng. Abs.*, 1933, (9), 67).—[In Japanese.] M. measured the change of volume and weight on heating of 4 kinds of loams usually employed in Japanese foundries and made some chemical analyses; by these means he was able to explain the irregular changes of properties. Similar investigations were carried out on silica sand, ordinary moulding sand, and sand for steel casting.—S. G.

XV.—FURNACES AND FUELS

(Continued from pp. 395-396.)

Standard Methods of Laboratory Sampling and Analysis of Coal and Coke (D 271-33). ——— (*Amer. Soc. Test. Mat. Standards*, 1933, (II), 269-308).

—S. G.

XVI.—REFRACTORIES AND FURNACE MATERIALS

(Continued from p. 396.)

Standard Method of Test for Porosity and Permanent Volume Changes in Refractory Materials (C 20-33). — (Amer. Soc. Test. Mat. Standards, 1933, (II), 176-178).—S. G.

Standard Method of Test for Softening Point of Fire-Clay Brick (C 24-33). — (Amer. Soc. Test. Mat. Standards, 1933, (II), 184-186).—S. G.

XXI.—INDUSTRIAL USES AND APPLICATIONS

(Continued from pp. 398-399.)

***Aluminium Vessels and Food Contamination.** C. A. Dunbar Mitchell (*J. Roy. Army Medical Corps*, 1933, 61, 99-107, 193-201; (*U.S.*) *Public Health Eng. Abs.*, 1933, 13).—Surveys of the physiological effects of aluminium have shown that no ill effects of any kind were produced by daily doses of alum up to an equivalent of 200 mg. of aluminium per diem. M. deals primarily with the chemical phase of the problem and attempts to measure the increase of aluminium content arising after foods have been cooked in aluminium vessels in the way that would normally be employed in the household. The results of various investigations show that with neutral foods there is no appreciable removal of aluminium. If cooked in bright pans, acid juices remove small amounts varying from 1-13 p.p.m. and in dark pans the amounts removed increase to from 16-41 p.p.m. Various methods for measuring aluminium content are described. The total amount of aluminium obtained when foods are cooked in aluminium vessels is 12 mg. per diem. Cooking in aluminium vessels removes daily quantities which are minute in comparison with those that can be administered without harm to normal adults. It is concluded that aluminium utensils can be used for storing water, for use as water-bottles, for frying or boiling or otherwise cooking foodstuffs, for heating or holding acid liquids or milk, without absorption of harmful amounts of the metal.—S. G.

***Report on Canned Fish in Aluminium Containers.** Chemical Laboratories, Royal Institute of Public Health, London (*J. State Medicine*, 1933, 41, 487-489; (*U.S.*) *Public Health Eng. Abs.*, 1933, 13).—Chemical examination of various fish products packed in hygienic aluminium containers disclosed that no aluminium could be detected. A similar examination of fish products in tin containers resulted in a finding of from 0.1 to 0.75 grain of tin per lb. This amount, however, is well below the limit of 2 grains per lb., at which stage toxic symptoms may develop. Opposition to the use of aluminium and aluminium utensils in contact with food is decried. From a study of the literature on the subject the following conclusions are reached: (1) aluminium is not a poisonous metal and there is no scientific evidence of its relationship to disease; (2) aluminium utensils are very resistant to corrosion by foodstuffs cooked therein; (3) aluminium does not accelerate the destruction of vitamins or other food substances during cooking.—S. G.

On the Uses of Aluminium in the Dairy Industry. — Camponaro (*Alluminio*, 1934, 3, 75-79).—Presented at the 10th International Dairy Congress, Rome, 1934. An illustrated review.—G. G.

The Use of Aluminium in the Cheese Industry. — Bonin (*Alluminio*, 1934, 3, 74-75).—Presented at the 10th International Dairy Congress, Rome, 1934. The uses of light metals in various branches of the cheese industry are dealt with.—G. G.

Light Alloy [25 S] Forgings and Stampings. — (*Provisional (British) Air Min. Aircraft Specification No. D.T.D. 106, 1930, 3 pp.*).—Covers the alloy known as 25 S.—S. G.

Light Alloy Airscrew Forgings (Fairey Reed Type). — (*Provisional (British) Air Min. Aircraft Specification No. D.T.D. 147, 1930, 3 pp.*).—S. G.

Light Alloy [Duralumin] Airscrew Forgings and Stampings (Detachable Blades and Complete Airscrews). — (*Provisional (British) Air Min. Aircraft Specification No. D.T.D. 150, 1930, 3 pp.*).—Covers Duralumin.—S. G.

Aluminium Alloy [Hiduminium R.R.] Forgings (For Sealing Rings of Cylinders). — (*Provisional (British) Air Min. Specification No. D.T.D. 128, 1930, 1 p.*).—Covers Hiduminium R.R. alloy.—S. G.

Aluminium Alloy [Hiduminium R.R. 53] Die-Castings (Suitable for Pistons, &c.). — (*Provisional (British) Air Min. Aircraft Specification No. D.T.D. 131, 1930, 2 pp.*).—Covers the alloy Hiduminium R.R. 53.—S. G.

Aluminium Alloy [Hiduminium R.R. 56] Forgings (Not Suitable for Pistons). — (*Provisional (British) Air Min. Aircraft Specification No. D.T.D. 130, 1930, 2 pp.*).—Covers the alloy Hiduminium R.R. 56.—S. G.

Aluminium Alloy [Hiduminium R.R. 59] Forgings (Suitable for Pistons). — (*Provisional (British) Air Min. Aircraft Specification No. D.T.D. 132, 1930, 3 pp.*).—Covers the alloy Hiduminium R.R. 59.—S. G.

Wrought Light Aluminium Alloy [Hiduminium R.R. 56] Tubes. — (*Provisional (British) Air Min. Material Specification No. D.T.D. 220, 1934, 4 pp.*).—Covers the alloy Hiduminium R.R. 56; sp. gr. 2.75.—S. G.

"Y" Aluminium Alloy Piston Forgings and Stampings. — (*Provisional (British) Air Min. Aircraft Specification No. D.T.D. 58A, 1932, 2 pp.*).—S. G.

Aluminium-Copper-Silicon Light Alloy Castings. — (*Provisional (British) Air Min. Aircraft Specification No. D.T.D. 84, 1929, 1 p.*).—S. G.

Aluminium-Silicon Alloy Sheets. — (*Provisional (British) Air Min. Specification No. D.T.D. 50, 1929, 1 p.*).—The sp. gr. of this alloy is approx. 2.68.—S. G.

Hard Aluminium-Magnesium Alloy Sheets. — (*Provisional (British) Air Min. Aircraft Specification No. D.T.D. 170, 1931, 2 pp.*).—The sp. gr. of this alloy is 2.68.—S. G.

Half-Hard Aluminium-Magnesium Alloy Sheets. — (*Provisional (British) Air Min. Aircraft Specification No. D.T.D. 175, 1931, 2 pp.*).—The sp. gr. of this alloy is 2.68.—S. G.

Soft Aluminium-Magnesium Alloy Sheets. — (*Provisional (British) Air Min. Aircraft Specification No. D.T.D. 180, 1931, 2 pp.*).—The sp. gr. of this alloy is 2.68.—S. G.

Standard Specifications for Fire-Refined Copper Other than Lake (B 72-33). — (*Amer. Soc. Test. Mat. Standards, 1933, (I), 577-579*).—Cover fire-refined copper, other than Lake, and not usually electrolytically refined. The material is intended for use in rolling into sheets and shapes for mechanical purposes, and is not intended for electrical purposes or for wrought alloys.—S. G.

Standard Specifications for Copper Bars for Locomotive Staybolts (B 12-33). — (*Amer. Soc. Test. Mat. Standards, 1933, (I), 676-678*).—Cover two grades—arsenical and non-arsenical.—S. G.

Standard Specifications for Copper Plates for Locomotive Fireboxes (B 11-33). — (*Amer. Soc. Test. Mat. Standards, 1933, (I), 713-715*).—Cover two grades—arsenical and non-arsenical copper, fire-refined or electrolytic, and hot-rolled from suitable cakes.—S. G.

Standard Specifications for Seamless Copper Boiler Tubes (B 13-33). — (*Amer. Soc. Test. Mat. Standards, 1933, (I), 679-682*).—Cover two grades—arsenical and non-arsenical.—S. G.