

# METALLURGICAL ABSTRACTS

(GENERAL AND NON-FERROUS)

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## I.—PROPERTIES OF METALS

(Continued from pp. 369-378.)

\*†Physical Properties of Materials. I.—Strengths and Related Properties of Metals and Wood. [Aluminium.] — (*Circ. Nat. Bur. Stand.*, 1937, C 101, (cdn. 2), suppt., 7 pp.).—Data relating to the properties, viz., sp. gr., yield-point, tensile strength, proportional limit, elongation, reduction of area, hardness, thermal expansion, and casting shrinkage of aluminium metal and its alloys, and tensile requirements of soft, medium hard, and hard aluminium, are tabulated. Corrections necessary to *Circ. No. 101* are given.—J. S. G. T.

\*Explosion of Aluminium Powder Dust Clouds. Ralph B. Mason and Cyril S. Taylor (*Indust. and Eng. Chem.*, 1937, 29, (6), 626-631).—The lower explosive limit of aluminium powder-dry air mixtures was found to be approx. 40 mg. of aluminium powder per litre of dry air. The lower limit of oxygen required to make an aluminium dust explosion impossible is approx. 10% of oxygen by volume, when diluted by carbon dioxide gas, and slightly less when the diluent is nitrogen. Two lots of powder are employed, with average particle size of 0.28 and 0.14 micron, respectively. The latter has excellent dispersion and suspension properties, and is believed to be one of the finest, thinnest, and most fluffy powders ever produced. A novel igniter for use in experimental explosion chambers was devised in the course of this work; it is illustrated and described.—F. J.

\*Effect of Reversed Deformation on Recrystallization [in Aluminium]. (Beck). See p. 437.

\*The Fatigue Resistance of Lead and Lead Alloys. (Summary Report.) H. Waterhouse (*Brit. N.-F. Metals Res. Assoc. Res. Rep.*, 1937, (440), 7 pp.).—Results relating to the fatigue resistance of lead and lead alloys, obtained during the course of a lengthy investigation by the Association of the mechanical properties of lead and lead alloys used for cable sheathing, water pipes, and rolled sheets, are collected and tabulated. The tables give (1) the endurance limits of lead in various conditions and of various degrees of purity, of lead alloyed with small proportions of one, two, or three of the elements tin, antimony, cadmium, calcium, barium, tellurium, copper, nickel, magnesium, bismuth, and of lead saturated with oxygen, and (2) the effect of surrounding media, e.g., air, rape oil, bitumen, and vaseline, on the endurance limits. Most of the tests were carried out at air temperature; a few were done at 100° C. in air.—J. S. G. T.

\*The Occlusion and Diffusion of Hydrogen in Metals. A Metallographic Study of Nickel-Hydrogen. George A. Moore and Donald P. Smith (*Trans. Electrochem. Soc.*, 1937, 71, 545-563; discussion, 563-564).—See *Met. Abs.*, this vol., p. 278.—S. G.

\*A Study of the Electrical Properties of Thin Films of Platinum Obtained by Cathode Sputtering in Air and Other Gases (He, N<sub>2</sub>, O<sub>2</sub>, and H<sub>2</sub>). A. Fery (*Proc. Phys. Soc.*, 1937, 49, (274), 136-137; discussion, 151-154).—Empirical relations between the electrical resistance of sputtered black platinum films and their thickness are derived and discussed. Black platinum has a resis-

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

† Denotes a first-class critical review.

tivity 42 times that of bulk platinum. The temperature coeff. of resistance is  $2.87 \times 10^{-4} - 29.9 \times 10^{-4}$ .—J. S. G. T.

**\*Inertia and Chemical Activity of the Rare Gases.—Action of Argon on Platinum Under the Influence of Electric Discharges.** H. Damianovich and G. Berraz (*Anales asoc. quim. argentina*, 1936, 24, (128), 149; *C. Abs.*, 1937, 31, 4870).—Cf. *Met. Abs.*, this vol., pp. 134, 143. A brief note. The apparatus used was like that used to produce compounds of platinum with helium, nitrogen, and oxygen. The argon was rigorously purified; nitrogen and oxygen were eliminated by magnesium, and hydrogen by cuprous oxide. After initial failures, due to the presence of other gases, particularly hydrogen, clear evidence was found of the fixation of spectroscopically pure argon by platinum. Since the discharge tube had been cleaned of gas at  $400^{\circ}\text{C}$ ., it was possible to subject the product in the tube to the action of heat, at increasing temperatures, for varying periods. The first evolution of argon from the compound was at  $200^{\circ}\text{C}$ . At higher temperatures there was indisputable evidence of evolution of argon. Contrary to the belief hitherto held, these tests show that argon is fixed on platinum in a rather stable form.—S. G.

**\*The Chemistry of Helium and Analogous Elements. I.—The Action of Mercury on Platinum-Helium Compounds.** H. Damianovich (*Anales asoc. quim. argentina*, 1936, 24, (128), 147; *C. Abs.*, 1937, 31, 4609).—With the object of subjecting to additional experimental verification the existence of stable platinum-helium compounds shown in prior work, mercury was treated at  $80^{\circ}$ – $100^{\circ}\text{C}$ . for 30 minutes to 3 hrs. with the platinum-helium compounds obtained by cathodic impact by the special technique already in use. The semi-solid amalgam obtained, in many cases containing all the helium which had combined with the platinum, on attack by 50% nitric acid gives a black precipitate containing platinum, mercury, and all the helium. The proportion of the latter varies from 0.20 to 4 c.c. per grm., depending on the helium combined with the platinum and on the percentage of platinum-helium compound contained in the amalgam. The platinum-mercury-helium complex has, so far, given two helium maxima, one at  $80^{\circ}$ – $100^{\circ}\text{C}$ ., and the other at  $200^{\circ}\text{C}$ ., with variations in the volume of the semi-solid mass. These definite decomposition temperatures, which are lower than those of solid Pt-He, are little affected by the quantity of helium compound contained in the compound used to form the amalgam. By X-ray spectra, D. compared the disappearance of the platinum structure in the amalgam and the disappearance of diffraction rings of definite diameter and appearance in the microcrystalline amalgams, and in the black precipitates obtained by nitric acid attack. The high stability of the platinum-helium compounds is shown beyond dispute.—S. G.

**\*Anomalous Diamagnetism of Selenium.** Mata Prasad and S. S. Dharmatti (*Indian J. Physics*, 1937, 11, (1), 1–8).—The effect of powdering and of colloidal dispersion on the magnetic properties of selenium was studied. The results suggest that during the process of powdering or dispersion, selenium is converted into an allotropic modification.—J. S. G. T.

**\*A Surface Property of Silver.** Naoto Kameyama and Shin-ichi Kikuchi (*Kogyo Kagaku Zasshi (J. Soc. Chem. Ind. Japan)*, 1937, 40, (1); *C. Abs.*, 1937, 31, 4876).—[In Japanese, with French summary in supplemental binding, pp. 17–18.] When a fine layer of metallic silver is coated on iron and then immersed in a solution of silver chloride or silver bromide in a current of hydrogen, without a trace of oxygen, the metallic silver layer becomes covered with a layer of silver chloride or silver bromide, while the interior of the silver layer remains unchanged. Addition of 0.002*N* sodium hydroxide to the solution gave the same result. Thermodynamic calculations indicate that the metallic silver should not be attacked by the alkaline halogen

salts in the absence of oxygen. The surface silver atoms are less stable than those in the interior of the layer.—S. G.

\*Contribution to Our Knowledge of the Mechanism of Compression and Recrystallization of Zinc. Michael Śmiałowski (*Z. Metallkunde*, 1937, 29, (6), 199–202).—Cubes were cut from zinc single crystals and compression tests carried out in the crystallographic directions [0001], [10 $\bar{1}$ 0], and [11 $\bar{2}$ 0]. Owing to copious twinning, the cube compressed in the [0001] direction shows the maximum deformability in the first stages, but work-hardening is rapid and the rate of reduction in height decreases very sharply when the applied load exceeds 5 kg./mm.<sup>2</sup>, more than 25 kg./mm.<sup>2</sup> being necessary to increase the reduction in height from 5 to 10%. When the cube is compressed in the [10 $\bar{1}$ 0] direction, a load of 24 kg./mm.<sup>2</sup> is necessary to effect a 4% reduction in height, but an 18% reduction is produced by only 28 kg./mm.<sup>2</sup> In the [11 $\bar{2}$ 0] direction the reduction in height follows a smooth curve, 13 kg./mm.<sup>2</sup> producing a 4% reduction and 18 kg./mm.<sup>2</sup> one of 16%. Recrystallization of zinc compressed perpendicular to the basal plane proceeds evenly throughout the specimen and grain-growth is very rapid at 260°–280° C. Zinc compressed in the [10 $\bar{1}$ 0] and [11 $\bar{2}$ 0] directions recrystallizes below 260° C. only in the vicinity of the distorted slip planes, but above 260° C. recrystallization gradually spreads throughout the specimen with the production of a very coarse structure, owing to absorption of the impurities which lie along planes parallel to the basal plane.—A. R. P.

\*On the Energy States of Valency Electrons in Some Metals. I.—Some Regularities Existing in Crystal Level Values and Those of the Atomic Spectrum of Zinc (6). Mituru Satō (*Nippon Kinzoku Gakkai-Si (Trans. Inst. Metals Japan)*, 1937, 1, (4), 161–164).—[In Japanese, with English abstract].—S. G.

\*Elastic Modulus and Damping as Functions of the State of the Metal. Fritz Förster and Werner Käster (*Z. Metallkunde*, 1937, 29, (4), 116–123).—See also Förster, *Met. Abs.*, this vol., p. 460. The elastic modulus ( $E$ ) and damping ( $\theta$ ) of numerous metals and alloys were measured in transverse freely-vibrating test-pieces, and the results are recorded graphically.  $E$  decreases at a slowly increasing rate with increase in temperature, whereas  $\theta$  increases similarly so long as the slip mechanism remains unaltered, but when a possibility of slip along new planes occurs, owing to the increase in temperature, the value of  $\theta$  increases steeply, e.g. at 225° C. in magnesium and at between 300° and 400° C. in aluminium. When a polymorphic change, or a change from ordered to disordered state occurs,  $E$  changes in a corresponding manner, but  $\theta$  increases rapidly in the transformation range, the increase starting at a temperature somewhat below this range. The value of  $\theta$  for the ferromagnetic state is greater than for the paramagnetic state; below the Curie point  $\theta$  may decrease with increase in temperature, but above this point it always increases. The value of  $E$  for soft nickel for transverse vibrations is greater in the ferro- than in the para-magnetic state. The values of  $\theta$  and  $E$  in the zinc-copper solid solution alloys and in the carbon-iron heterogeneous alloys decrease with increasing content of alloying constituent (zinc or carbon), but in annealed  $\alpha$ -brass  $\theta$  increases in a smooth flat curve with increasing grain-size. Increase in hardness by ageing or ordering processes increases  $\theta$ , and in copper-iron and cobalt-chromium-iron alloys  $E$  also, but in gold-copper alloys ordering decreases  $E$ . Cold-working of a metal decreases  $E$  and strongly increases  $\theta$ ; on annealing,  $\theta$  decreases at relatively low temperatures owing to relief of internal stresses, and reaches its minimum value at just below the recrystallization temperature, whereas  $E$  increases regularly with increase in temperature up to the recrystallization temperature above which there is a rapid increase in  $E$ . Heat-, stretching-, or hardening-stresses increase  $\theta$ ; as they are relieved by storage or annealing,  $\theta$  is correspondingly reduced. Inter-crystalline corrosion and hollow spots

of any kind increase 0; it is possible by making definite assumptions to ascertain the position of cavities in a test-piece by measuring  $\theta$ . From the above it will be seen that the resonance method is a useful way of testing materials, without injuring them in any way, to ascertain their homogeneity and state of stress.—A. R. P.

\*The Variation with Temperature of the Hardness of Metals, as Determined by Means of a Cone Subjected to Pressure.—III. [Copper, Nickel, Molybdenum, Tungsten.] J. Engl and J. Katz (*Z. Physik*, 1937, 106, (1/2), 1-8).—Experimental data are tabulated relating to the hardness of copper, nickel, molybdenum, and tungsten, determined by means of the method in which pressure is applied to a conical surface, at 100° to -190° C. All the metals used were annealed in nitrogen at about 1000° C. The results are compared with those given in previous papers (*Met. Abs.*, 1935, 2, 619; 1936, 3, 112). The following temperature-coeffs. of hardness, ( $dH/dt$ ), at -190° C. are derived: copper, 0.065; nickel, 0.086; molybdenum, 2.0; tungsten, 1.8 kg./mm.<sup>2</sup>/deg.—J. T.

\*Variation of Internal Friction of Solids Under the Influence of Heat- and Mechanical-Treatments: Effect of Tension. Raymond Jacquesson (*Compt. rend.*, 1937, 205, (6), 357-360).—The internal friction,  $K$ , of a torsion wire, is given by  $1 + \frac{W}{2bA^2} = 1 + \frac{P}{A}$ , where  $W$  is the energy lost per cycle owing to mechanical hysteresis,  $A$  is the amplitude,  $P$  the loss ( $A_n - A_{n+1}$ ), and  $b$  is a constant. In the case of tensile stress less than the elastic limit, the curve  $K = f(A)$ , which at first rapidly ascends, tends to become a straight line after a certain time. With aluminium wire of large crystals,  $K$  eventually becomes constant. The variations of  $K$  are irreversible. Relative to a given amplitude,  $K$  diminishes with the time and tends towards a limit according to:  $K - K_\infty = (K_0 - K_\infty)e^{-\lambda t}$ , where  $\lambda$  is a constant for the amplitude considered. In the case of tensile stress near to or above the elastic limit, the law of variation of  $K$  as a function of the time is no longer exponential. There appears the resultant effect of two inverse modifications: a reaction of the crystals with more or less rapid evolution towards a more stable state characterized by lower internal friction, and a destructive effect of the crystal edifice under the influence of high tensile stress. Internal tensile stresses behave as external tensions. The law of variation is still an exponential, with  $\lambda$  of the same order as above. If, therefore, the internal friction of a wire in a given state is to be measured, tensile effects must be avoided. The correct method is that of the double wire pendulum, in which the lower wire is the one to be examined.

—J. H. W.

\*New Transformations Produced at Low Temperature (Frigadréactions). André Debierne and Ladislas Goldstein (*Compt. rend.*, 1937, 205, (5), 321-322).—Low temperature reactions with carbon were previously investigated (*ibid.*, 1937, 205, 141), and the experiments are now extended to other material, using the same method. Occluded gas is removed from the metal by heating *in vacuo*, the metal is cooled in a bath of liquid nitrogen until thermal equilibrium is obtained, and a small quantity of pure helium or hydrogen is introduced. Preliminary results are: (1) helium on beryllium—very large thermal reaction; (2) hydrogen on beryllium and helium on magnesium—considerable reaction; (3) helium on aluminium—less reaction; (4) helium on nickel—still less reaction; (5) helium on copper—probably no reaction. Tentative explanations are put forward to account for these results.—J. H. W.

\*†The Structure of Thin Metallic Films. G. I. Finch (*Proc. Phys. Soc.*, 1937, 49, (274), 113-117; discussion, 151-154).—Attention is directed to those structural features of thin metallic films which are likely to give rise, at least in part, to the abnormally low electrical conductance of such films. Evidence of the structure of films is obtainable by means of electron diffraction. Sputtered films are not regarded as suitable for critical conductivity measure-

ments. Films should be deposited in high vacuum, care being taken to prevent contamination by grease, mercury, or gas. Wide temperature variation of the substrate should be avoided. A *bibliography* of 34 references is appended.—J. S. G. T.

\*†**Some Factors Influencing the [Electrical] Resistance of Thin Metal Films.** E. T. S. Appleyard (*Proc. Phys. Soc.*, 1937, 49, (274), 118–135; discussion, 151–154).—Some of the chief experimental observations on the electrical resistance of metal films prepared by evaporation deposition in a good vacuum are discussed. A *bibliography* of 38 references is given.—J. S. G. T.

\***A Study of the Electrical Properties of Thin Films of Platinum Obtained by Cathode Sputtering in Air and Other Gases (He, N<sub>2</sub>, O<sub>2</sub>, and H<sub>2</sub>).** (Féry). See p. 425.

**Fluctuations in the Resistance of Thin Films.** J. Bernamont (*Proc. Phys. Soc.*, 1937, 49, (274), 138–139).—Fluctuations in the value of the electrical resistance of thin metallic films in varying electric fields of different frequencies are briefly discussed.—J. S. G. T.

†\***The Migration and Aggregation of Atoms on Solid Surfaces.** J. E. Lennard-Jones (*Proc. Phys. Soc.*, 1937, 49, (274), 140–150; discussion, 151–154).—Discusses mathematically the problems: (1) to determine the most stable configuration of atoms deposited as a thin film on a substrate, and (2) to determine the time taken by the deposit to change from its initial configuration to the most stable one. A *bibliography* of 20 references is appended.—J. T.

\***A Static Method for Determination [of the] Equilibria of Metals with Carbon Dioxide.** A. F. Kapustinsky and Anna Silberman (*Acta Physico-chimica U.R.S.S.*, 1936, 4, (4), 495–504).—[In English.] A method is described, based on Deville's principle, for determining equilibrium conditions for reactions between a metal (M), carbon dioxide, and carbon monoxide, of the type  $M + CO_2 \rightleftharpoons MO + CO$ . A constant pressure of one component of the gaseous mixture is maintained in the apparatus by producing its solid phase. Equilibrium in the reaction  $Sn + 2CO_2 \rightleftharpoons SnO_2 + 2CO$  is investigated, the factor of thermal diffusion being taken into account. Values of the free energy and heat content of the components of the reaction are calculated, and the equilibrium and dissociation constants of the reaction  $2SnO_2 + 3C \rightleftharpoons 2Sn + CO_2 + 2CO$  are indirectly calculated.—J. S. G. T.

†**Seventh Report of the Atomic Weights Committee of the International Union of Chemistry.** G. P. Baxter, O. Hönigschmid, and P. Lebeau (*Bull. Soc. chim. France*, 1937, [v], 4, (6), 957–970).—See *Mct. Abs.*, this vol., p. 133. —A. R. P.

**Discontinuous Change in Magnetization in Ferromagnetic Substances.**—H. Kiyoshi Murakawa (*Proc. Phys.-Math. Soc., Japan*, 1937, 19, (8), 715–733).—[In English.] See also *Mct. Abs.*, this vol., p. 82. The magnetic hysteresis curve of ferromagnetics consists of 4 regions: (1) a region of initial reversible permeability; (2) a region of reversal process; (3) a region of rotation process; and (4) a region of saturation. The so-called Barkhausen noise, indicating a discontinuous change of magnetization, is heard mainly in region (2). Photographic records of the discontinuities obtained with poly- and single-crystals of iron and nickel, employing either a Braun tube or an electromagnetic oscillograph, are given and discussed.—J. S. G. T.

**An Explanation of the Maximum in the Secondary Electron Emission from Metals.** D. R. Bhawalkar (*Proc. Indian Acad. Sci.*, 1937, 6, (1), 74–78).—The curve plotted with  $I_s/I_p$  as ordinates ( $I_s$  denoting the total secondary electron emission corresponding to the primary electron emission,  $I_p$ , of energy  $V$  volts) and  $V$  as abscissæ shows a flat maximum at large values of  $V$ . This effect is explained by assuming that the rate of loss of energy of the primary electrodes obeys the Thomson-Whiddington law and that secondary electrons are absorbed by the target on their way out.—J. S. G. T.

## II.—PROPERTIES OF ALLOYS

(Continued from pp. 378-380.)

†**Light Metal Bearings.** Reinhold Hinzmann (*Z. Metallkunde*, 1937, 29, (5), 158-162).—Elektron alloys containing zinc 0.5-3, aluminium 6-10, and manganese 0.3% have a heat conductivity of 0.32 grm.-cal./cm./sec./° C. and a coeff. of expansion of  $24-25.5 \times 10^{-6}$  between 20° and 100° C.; when used in bearings they will withstand surface pressures of 150-400 kg./cm.<sup>2</sup> without the temperature exceeding 100° C. A 10% copper-aluminium alloy containing about 4 volume-% of graphite has proved a satisfactory substitute for bearing bronze, running cooler and requiring less oil. Borotal alloys (containing copper 3-4% with lead, iron, and sometimes zinc in addition to graphite) have also given good results as bearing metals in Germany, but Quarzal (aluminium with copper 5, iron or nickel 1%, and other metal of unstated nature 0.5%) and KS 280 (aluminium with silicon 21-22%, cobalt copper and nickel 1.2-1.5% each, and manganese and magnesium 0.5-0.6% each) are more widely used. The structure of these alloys is illustrated, and their running properties under various conditions are shown graphically.  
—A. R. P.

\***The Influence of the Elements Aluminium, Titanium, Vanadium, Copper, Zinc, Tin, and Antimony on the Polymorphic Transformation of Cobalt.** Werner Köster and Ewald Wagner (*Z. Metallkunde*, 1937, 29, (7), 230-232).—On addition of any of the above metals to cobalt, the temperature of the polymorphic transformation  $\epsilon$ - $\gamma$  changes considerably, and the hysteresis between the heating (Ac) and cooling (Ar) points becomes greater. With aluminium the Ar line falls linearly to 0° C. and the Ac line linearly to 150° C. at 5% aluminium; with titanium the Ar line falls linearly to 160° C. and the Ac line in a smooth curve to 350° C. at 7.2% titanium; with vanadium the Ar line falls in a slight curve to 0° C. and the Ac line rises linearly to 600° C. with 12% vanadium; with copper the Ar line is similar to the vanadium line, but the Ac line falls to 380° C. with 12% copper; with Zn both lines are straight, the Ar reaching 0° C. at 14% zinc and the Ac 600° C. at 16% zinc; with tin the Ar line falls to 130° C. and the Ac line to 380° C. at 5% tin; and with antimony the Ar line falls to 190° C. and the Ac line rises to 530° C. at 8.5% antimony. The magnetic transformation point is lowered to 780° C. by 5.2% aluminium, to 890° C. by 7.2% titanium, to 1040° C. by 12% copper, to 1070° C. by 9% tin, and to 990° C. by 8.5% antimony; these figures are therefore the limit of solid solubility of these elements in cobalt at these temperatures (see also abstract below).—A. R. P.

\***The Influence of the Elements Beryllium, Carbon, and Silicon on the Polymorphic Transformation of Cobalt.** Werner Köster and Eberhard Schmid (*Z. Metallkunde*, 1937, 29, (7), 232-233).—See also preceding abstract. The cobalt-CoBe eutectic is at 4.2% beryllium and 1115° C., cobalt at this temperature retaining 2.5% beryllium in solid solution and at room temperature about 1.4%. The magnetic transformation point decreases with increasing beryllium content up to the limit of solid solution, after which it remains constant at 950° C. Addition of beryllium to cobalt broadens the hysteresis range of the polymorphic transformation, which in the heterogeneous region occurs at 550° C. on heating and at 265° C. on cooling, instead of at 400°-420° C. for the pure metal. Carbon has a similar effect on this transformation; with more than 0.1% carbon it occurs at 390° C. on heating and at 90° C. on cooling, indicating that 0.1% is the limiting solid solubility of carbon in cobalt at temperatures below 600° C. The solid solubility of silicon in cobalt is 7.8% at 20° C. and 9.5% at the eutectic temperature, 1205° C.; the polymorphic transformation temperature rises linearly with silicon content and the line cuts the solubility line at 1180° C., 9.5% silicon, while the magnetic trans-

formation line falls linearly, cutting the transformation line at 800° C., 4.7% silicon, and the solubility line at 580° C., 8% silicon.—A. R. P.

\***Interim Report on the Fatigue of Round Cadmium-Copper Trolley Wires.**—(Rep. Brit. Elect. Allied Res. Assoc., 1937, (Ref. F/T 111), 29 pp.; *Sci. Abs.*, 1937, [B], 40, 356).—Fatigue tests were carried out by rotating bending methods at zero mean stress on samples of cadmium-copper trolley wires, of 3 different cadmium contents, drawn in each case from both hot-rolled and semi-cold rolled rod. Stress-strain curves were obtained, and the ultimate tensile strengths were found. The fatigue tests were carried out both on wires of full diameter and on specimens which had been turned down. Other tests, also at zero mean stress, were carried out by axial loading methods on machined specimens. The results of the tests by the two different methods on machined samples show reasonably close agreement, and in the case of these machined specimens the fatigue strength was found, in general, to increase as the tensile strength increased. In all cases, there is a very marked decrease in the endurance limit of specimens of full diameter compared with that of machined samples of the same wire, and there is some evidence of a tendency for the fatigue strength to decrease as the tensile strength increases. Some results of tests on fatigue strength by axial loading methods at a high mean stress on machined samples are included, but similar tests on wires of full diameter were found unreliable, owing to the difficulty experienced in preparing the ends of the specimens in such a way as to avoid fracture at the machine jaws.—S. G.

\***Mechanically Soft Permanent-Magnet Alloys of Copper, Nickel, and Iron.** Hans Neumann, Artur Büchner, and Hermann Reinboth (*Z. Metallkunde*, 1937, 29, (6), 173-185).—The magnetic properties of alloys containing copper 50-75, iron 10-25, and nickel 10-40% after various heat- and mechanical-treatments are shown in a series of graphs. The best properties are shown by alloys having a copper-nickel-iron ratio of about 60 : 20 : 20. Quenching the cast alloys from 900°-1050° C., followed by annealing at 600°-650° C., improves considerably the magnetic properties, maximum values of remanence ( $B_r = 3420$ ) and coercivity ( ${}_B H_c = 390$ ) being obtainable in this way. When the alloy is cold-drawn to 0.3 mm. wire and annealed at 600°-650° C.,  $B_r = 6000$  and  ${}_B H_c = 490$ . Rolling produces a preferred magnetic direction, depending on the rolling structure. The remanence is relatively insensitive to plastic deformation, but a considerable increase in coercivity can be obtained by subjecting the alloy to elastic tensile stresses. The alloys with around 60-70% copper can all be cold-rolled to about 95% reduction without difficulty, even in the magnetically-hard state. The 60 : 20 : 20 alloy rolled to 80% reduction and annealed has a tensile strength of 48 kg./mm.<sup>2</sup>; this is increased to 68.5 kg./mm.<sup>2</sup> by rolling to strip.—A. R. P.

\***A Supplementary Research on the Equilibrium Diagram of the Copper-Tin System.** Matsujiro Hamasumi and Yoshido Odamura (*Nippon Kinzoku Gakkai-Si (Trans. Inst. Metals Japan)*, 1937, 1, (4), 165-167).—[In Japanese.] Using a specially sensitive thermo-element, differential thermal analyses were made of alloys containing 24.5-35% tin. A thermal change in four alloys containing 25, 26.01, 27, and 28% tin was found in the so-called  $\gamma$ -field. It is concluded that the  $\beta + \gamma$  field exists from the peritectic temperature at 738° C. down to the non-variant transformation at 570° C., and hence the change at 570° C. should be a eutectoid transformation of the type  $\beta = \alpha + \gamma$ , as has been suggested by some investigators.—S. G.

\***The Equilibrium Diagram for the System Cu-Sn and the Transformations Associated with the Decomposition of the Solid Solution  $\alpha$ .** S. T. Konobeevski and W. P. Tarassova (*Acta Physicochimica U.R.S.S.*, 1937, 6, (6), 781-798).—[In English.] The equilibrium lines between the region of  $\alpha$ -solid solution and the two-phase regions  $\alpha + \gamma$  and  $\alpha + \epsilon$  were determined by X-ray crystal

analysis. An intermediate phase,  $\epsilon'$ , which is liberated from the solid solution,  $\alpha$ , below  $380^{\circ}\text{C.}$ , was detected and studied. The present results agree best with those obtained by Haase and Pawlek (*Met. Abs.*, 1936, 3, 198). The lattice of the  $\epsilon'$ -phase is found to constitute a rhombic cell with 32 atoms.—J. S. G. T.

\***Determination of the Limiting Solubility of the  $\alpha$ -Phase in the Ternary System Copper-Zinc-Tin at Low Temperatures by the Method of X-Ray Analysis.** S. T. Konobeevski, W. P. Tarassova, and A. A. Stepanova (*Acta Physicochimica U.R.S.S.*, 1937, 6, (6), 799-814).—[In English.] The transformation of the solid solution of the  $\alpha$ -phase in the copper-zinc-tin system of alloys on annealing in different initial states (after quenching, on slow cooling, and after straining) was studied. In strained samples the process of decomposition is considerably accelerated. The solid solution boundary is plotted in three isothermal sections corresponding to  $500^{\circ}$ ,  $350^{\circ}$ , and  $310^{\circ}\text{C.}$ —J. S. G. T.

\***On the Gold-Manganese Alloys.** V. A. Nemilov and A. A. Rudnizkiy (*Izvestia Sektora Platini (Ann. Sect. Platine)*, 1936, 13, 129-144).—[In Russian.] A more detailed account of the results previously published; see *Met. Abs.*, 1936, 3, 149.—N. A.

\***The Fatigue Resistance of Lead and Lead Alloys (Summary Report).** (Waterhouse.) See p. 425.

\***The Magnesium Corner of the Magnesium-Aluminium-Cadmium System.** Werner Köster and Walter Dullenkopf (*Z. Metallkunde*, 1937, 29, (6), 202-204).—The equilibria in alloys containing more than 80% magnesium were determined by thermal analysis, and the results are shown graphically for alloys with 5 and 10% cadmium, and for alloys with cadmium-aluminium ratios of 2:1 and 1:2. In alloys with 5% cadmium, the  $\epsilon$  (magnesium-rich)-solid solution extends to 1.2% aluminium at  $20^{\circ}\text{C.}$ , 4% aluminium at  $300^{\circ}\text{C.}$ , and 13.5% aluminium at the eutectic temperature ( $420^{\circ}\text{C.}$ ); the corresponding values for the 10% cadmium alloy are 0.8%, 3%, and 11% aluminium. With a 1:2 aluminium-cadmium ratio, the range of  $\epsilon$  at the eutectic temperature extends to 84% magnesium, and with a 2:1 ratio to 72% magnesium. Alloys with more than 6% aluminium and 5-10% cadmium can be hardened by quenching from  $420^{\circ}\text{C.}$  and re-heating at  $200^{\circ}\text{C.}$  (5% cadmium) or  $250^{\circ}$ - $300^{\circ}\text{C.}$  (10% cadmium), a maximum hardness of 80 Brinell units being obtained with 13% aluminium and 5% cadmium.—A. R. P.

\***The Structure of Magnesium-Rich Magnesium-Calcium Alloys.** Hugo Vosskühler (*Z. Metallkunde*, 1937, 29, (7), 236-237).—Thermal analysis and micrographic examination of alloys with up to 60% calcium show the presence of one compound only, viz.  $\text{Mg}_2\text{Ca}$ , melting at  $714^{\circ}\text{C.}$  and forming a eutectic with magnesium at 16.3% calcium and  $516^{\circ}\text{C.}$   $\text{Mg}_2\text{Ca}$  also forms a eutectic with calcium, melting at  $445^{\circ}\text{C.}$  The solubility of calcium in magnesium is 0.18% at  $300^{\circ}\text{C.}$ , 0.29% at  $400^{\circ}\text{C.}$ , 0.66% at  $500^{\circ}\text{C.}$ , and 0.78% at the eutectic temperature.—A. R. P.

\***The Equilibrium Diagram of the Magnesium-Lithium System.** F. I. Schamray and P. J. Saldau (*Izvestia Akademii Nauk S.S.S.R. (Bull. Acad. Sci. U.R.S.S.)*, 1936, [Chem.], (2), 349-362).—[In Russian, with French summary.] See abstract from German source, *Met. Abs.*, 1935, 2, 577.—N. A.

\***On the Solid Solution Series Magnesium-AgCd<sub>3</sub> in the Ternary System Magnesium-Silver-Cadmium.** Fritz Laves and Kurt Moeller (*Z. Metallkunde*, 1937, 29, (6), 185-189).—Thermal and X-ray analysis and micrographic examination of alloys of magnesium and  $\text{AgCd}_3$  show that above  $300^{\circ}\text{C.}$  the constituents form a continuous series of solid solutions, with a minimum melting point of  $420^{\circ}\text{C.}$  at 50 atomic-% magnesium. Alloys with 35-70 atomic-% magnesium undergo a transformation at temperatures varying between  $194^{\circ}$  and  $271^{\circ}\text{C.}$ , according to the magnesium content, the 50 atomic-% alloy having the highest transformation temperature. The low temperature modification has a close-packed hexagonal structure with superstructure,



and that of the 50 atomic-% alloy is identical with that of MgCd. These results show that an intermetallic compound which obeys the Hume-Rothery rule can readily form a series of solid solutions with an element having a similar lattice structure.—A. R. P.

**\*Spectroscopic Study of the Conductibility Electrons in Magnesium and Aluminium Alloys.** Jules Farineau (*Compt. rend.*, 1937, 205, (6), 365-366).—The *K* emission spectra of magnesium and aluminium, beginning with the alloys  $Al_2Mg_3$  and  $Al_3Mg_2$ , were studied by means of a vacuum spectrograph with a curved crystal. In these alloys, the magnesium and aluminium atoms pool their valency electrons (2 for magnesium, 3 for aluminium). If it is allowed that all these electrons can fall on a level *K*, either an aluminium or a magnesium ion, the intensity, *I*, of the ray in the two cases equals  $f(E - E_0) \times n(E - E_0)$ , where *f* is the probability of passage and practically the same in both cases, and  $n(E - E_0)$  is the number of electrons of kinetic energy  $(E - E_0)$ , and is evidently independent of the emitted ray. The distribution of the intensity should thus be the same in the same alloy for the rays of magnesium or of aluminium, and this was confirmed.—J. H. W.

**\*Contribution to the Knowledge of the Alloy Kovar [or Fernico].** Werner Hessenbruch (*Z. Metallkunde*, 1937, 29, (6), 193-195).—Kovar, or Fernico, alloys contain nickel 23-30, cobalt 30-17, and manganese 0.6-0.8% (remainder iron), and have coeff. of expansion about equal to those of hard glasses, the expansion curves even showing a point of inflection at the softening point of the glass. It is possible, therefore, to make gas-tight joints in glass with quite thick wires. The hard-drawn alloys slightly increase in hardness when annealed at 400°-500° C., but become dead soft at 700°-800° C. Well-annealed alloys consist of a homogeneous solid solution, but the cast alloys consist of two solid solutions, and alloys annealed at 500° C. show signs of precipitation. On annealing at 1300° C., martensitic needles are formed; alloys quenched from this temperature and annealed at 500° C. for 2 hrs. show a 50% increase in hardness.—A. R. P.

**\*The Atomic Moments and Curie Points of Solid Solutions of Nickel.** Victor Marian (*J. Physique*, 1937, [vii], 8, (7), 313-315).—Data, due to various observers, relating to the atomic moments (*M*) and Curie points (*θ*) of solid solutions of nickel alloyed with various non-ferromagnetic elements, viz., copper, zinc, aluminium, tin, antimony, and molybdenum, are represented by the ordinates of graphs in which the proportions of nickel ( $\tau$ ), contained in the alloys are the abscissæ. In general, *M* and *θ* decrease linearly with increase of  $\tau$ , and both attain zero value at approximately the same value of  $\tau$  in the case of any single alloying metal. The rate of decrease of *M* and *θ* with  $\tau$  is more rapid the greater the valency, *n*, of the alloying metal. When, in place of  $\tau$ , one plots as abscissæ in the respective graphs, the value of  $n\tau$ , the electronic proportion of the alloying metal, then the respective sets of straight lines in the two sets of graphs become very approximately superposed. The variations of *M* and *θ* are therefore controlled principally by the number of superficial electrons in the alloys. The inclinations of the two sets of straight lines suggests that the addition of one electron increases the value of *M* by one Bohr magneton.—J. S. G. T.

**\*On the After-Effect Losses in Nickel-Iron Alloys.** Ernst Seyffert (*Z. tech. Physik*, 1937, 18, (7), 200-203).—In addition to hysteresis and eddy current losses in ferromagnetic materials, there is a residual loss, to a large extent independent of the amplitude and frequency of the current, which, from analogy with corresponding mechanical and dielectric losses, H. Jordan has termed "Nachwirkung" loss. The dependence of this loss on composition, heat-treatment, and temperature is here investigated for iron, nickel, and their complete series of alloys. The effect attains a maximum value in the case of an alloy containing about 30% of nickel; this confirms a result obtained by Gold-

schmidt. This is attributed to the occurrence in the 30% nickel alloy of a degree of inhomogeneity, producing what Goldschmidt calls the mixed-body effect (*Mischkörpereffekt*).—J. S. G. T.

\*On the Influence of Mechanical Treatment on the Electrical Properties of Iron-Nickel Alloys. H. Reel (*Wis- en natuurkundig Tijds.*, 1935, 7, 159-175; *Chem. Zentr.*, 1935, 106, (II), 1772).—Mechanical and thermal treatment of Invar considerably affects the thermo-potential between a lower limit of deformation and an upper limit preceding recrystallization. Oxide formation increases the thermo-potential, the maximum value being attained by heating to 650° C.—S. G.

**Magnetic Alloys: Their Properties and Uses.** Lewis W. Phillips (*Elect. Ind.*, 1937, 37, (1893), 949-952).—Includes a brief account of the properties of the "Telcon" nickel-iron alloys and of the new Japanese "Super-Permalloys," "Super-Resistivity Permalloys," and "Super-Perminvars," prepared by additions of cobalt, silicon, tin, and titanium (see Nishina, *Met. Abs.*, this vol., p. 89).—J. C. C.

\*Equilibrium Relations in the Nickel-Tin System. William Mikulas, Lars Thomassen, and Clair Upthegrove (*Trans. Amer. Inst. Min. Met. Eng.*, 1937, 124, 111-133; discussion, 133-137; and *Metals Technology*, 1937, 4, (5), 23 pp.; *A.I.M.M.E. Tech. Publ. No. 814*).—The equilibrium diagram of the nickel-tin system was redetermined by thermal and micrographic examination, and the solid solubility of tin in nickel further investigated by the X-ray method. The structures of three of the intermetallic compounds formed were partially determined, though no attempt was made to establish the range of homogeneity of these phases. The liquidus rises rapidly from the melting point of pure tin at 232° C. to 793° C. at 4.5% nickel, with no indication of a eutectic. The solid phase here separating is Ni<sub>3</sub>Sn<sub>1</sub>, the same phase being produced by a peritectic reaction at 793° C. in the range 4.5-43% nickel. Between 4.5 and 18% nickel the melt consists of two liquids. From 18% nickel at 793° C. the liquidus rises again to 1253° C. at 24% nickel, the solid separating being Ni<sub>3</sub>Sn<sub>2</sub>. Between 24 and 46% nickel the melt again consists of two liquids. Beyond 46% the liquidus falls to the eutectic at 1124° C. and 68.5% nickel, the solid phases separating being α-Ni<sub>3</sub>Sn<sub>2</sub>, Ni<sub>3</sub>Sn, and Ni<sub>4</sub>Sn, consecutively. The latter phases are formed also by the peritectic reactions: Ni<sub>3</sub>Sn<sub>2</sub> + liq. ⇌ Ni<sub>3</sub>Sn at 1164° C., and Ni<sub>3</sub>Sn + liq. ⇌ Ni<sub>4</sub>Sn at 1143° C. Ni<sub>3</sub>Sn<sub>2</sub> undergoes a transformation at 902° C.; X-ray diffraction photographs of filings quenched from below 902° C. show a hexagonal structure of the nickel arsenide type having 1 molecule per unit cell, with  $a = 4.092 \text{ \AA}$ ,  $c/a = 1.267$ ; above 902° C. the structure is body-centred tetragonal, with 10 molecules per unit cell, where  $a = 9.199 \text{ \AA}$ ,  $c/a = 0.933$ . Ni<sub>4</sub>Sn is stable only between 1142° and 941° C., decomposing at the higher temperature into Ni<sub>3</sub>Sn + liq., and at the lower into Ni<sub>3</sub>Sn + α; the structure appears to be tetragonal, with 2 molecules per unit cell, where  $a = 5.111 \text{ \AA}$ ,  $c/a = 0.955$ . Beyond 68.5% nickel the liquidus rises gradually to the melting point of pure nickel at 1452° C., the solid separating being the α-solid solution of tin in nickel. This α-solid solubility curve as determined by the authors by the X-ray method differs considerably from that obtained by E. R. Jette and E. Fetz by the same method. In discussion, J. and F. attribute this difference to their own more rapid quenching technique.—P. W. R.

\*Determination of Latent Heats of Vaporization of the Selenides of Cadmium and Mercury and Telluride of Zinc from the Absorption Spectra of their Vapours. L. S. Mathur (*Indian J. Physics*, 1937, 11, (3) 177-185).—The latent heats of vaporization of the selenides of cadmium and mercury, and the telluride of zinc, deduced from their absorption spectra, are found to have the values: CdSe, 39.40; HgSe, 83.23; ZnTe, 61.78 k. cal.—J. S. G. T.

\*The Effect of Cold-Work and Annealing on the Hardness of Some Tin-Antimony, Tin-Antimony-Copper, and Tin-Antimony-Silver Alloys. R. E. Leyman (*Tech. Publ. Internat. Tin Res. Develop. Council, Series A*, 1937, (53), 18 pp.).—The alloys investigated contained about 3, 5, and 7% antimony, respectively. Additions of 0.5, 1, and 3% copper were made to the 5% alloy, and similar additions of silver were made to the 7% alloy. All the alloys are, in general, hardened by slight or moderate cold-rolling. They are softened by further rolling, sometimes becoming softer than in the cast condition. The softening on severe working is more pronounced with the specimens containing the higher proportions of the metals alloyed with the tin. Most of the alloys are further softened if annealed after rolling, but those containing 3% copper or 0.5–3% silver recover some of their lost hardness on annealing after severe working. Various quenching and ageing treatments had no marked effect on the physical properties of the tin-antimony and tin-antimony-copper alloys. The tin-antimony-silver alloys show an appreciable increase in hardness on quenching, but this is rapidly lost at 100° C., and disappears in 100 days at room temperature.—J. S. G. T.

\*Mechanical Properties of Some White Bearing Metals and Other Tin-Base Alloys at Various Temperatures. C. E. Homer and H. Plummer (*Tech. Publ. Internat. Tin Res. Develop. Council, Series A*, 1937, (57), 20 pp.).—Determinations were made of the tensile strength, Brinell hardness, influence of rate of straining on tensile strength, and the rate of cooling of some binary tin-rich alloys, and of some tin-antimony-copper alloys typical of tin-base bearing metals. In addition, the effects of the addition of cadmium to the alloys were investigated, and series of tin-rich alloys of the tin-antimony-cadmium and tin-copper-cadmium systems were tested. Addition of cadmium increases the strength and hardness of the tin-antimony and tin-antimony-copper alloys. There is, on the whole, a continuous increase in strength with increasing cadmium content, but the extent of the increase becomes progressively less. In most cases, there is not much advantage in adding >3% cadmium. When the alloys are to be subjected to high temperatures, the cadmium content may have to be limited, as some of the alloys contain a constituent, probably a eutectic, melting at about 170° C. This appears when the cadmium content reaches about 3% in a bearing metal containing 7% antimony and 3.5% copper. Increase of antimony content favours retention of cadmium in solid solution, and thus prevents the appearance of this constituent; reduction of antimony content causes the constituent to appear at a lower cadmium content. The increased strength due to cadmium addition is retained on heating. The two series of tin-copper-cadmium alloys tested do not appear to possess any particularly useful properties which cannot be obtained more easily in other alloys.—J. S. G. T.

\*The Tensile Properties of a Series of White Metal Bearing Alloys at Elevated Temperatures. H. Greenwood (*Tech. Publ. Internat. Tin Res. Develop. Council, Series A*, 1937, (58), 9 pp.).—The tensile properties of commercial tin- and lead-base bearing metals were tested at temperatures up to 175° C., and the effects of additions of lead or cadmium to two of the tin-base alloys were investigated. The tin alloys contained 5.05–92.3% tin; the lead alloys contained 0.30–79.9% lead. The maximum stress and yield-point are found, in every case, to decrease fairly uniformly with increase in temperature, while values for the elongation and reduction of cross-section increase. The yield-point/temperature curves are all similar to that for maximum stress, but have a slightly smaller slope. The ductility curves are more irregular; the increase of ductility with temperature is very much greater from 100°–175° C. than from room temperature up to 100° C. The alloy containing 92.3% tin loses a smaller proportion of its tenacity with increase of temperature than do any of the other alloys. The marked increase of

tensile strength at room temperature effected by the addition of 1% of cadmium to one of the alloys (88.8% tin) is not maintained at higher temperatures. The addition of 3.5% lead to an alloy containing 85.5% tin produces definitely harmful effects. The highest values of ductility were given, in the higher temperature range, by the two alloys containing (a) tin 39.8, lead 48.6; and (b) tin 5.05, lead 79.9%. The alloys are arranged according to their tensile strengths at 18° C. and at 175° C.—J. S. G. T.

**\*Deformable Alloys of Titanium.** Wilhelm Kroll (*Z. Metallkunde*, 1937, 29, (6), 189–192).—Alloys of titanium with 2–9% of molybdenum, tungsten, nickel, iron, cobalt, beryllium, silicon, manganese, chromium, copper, aluminium, zirconium, vanadium, and tantalum were prepared by sintering cylinders of the compressed powders in a high vacuum at just below the melting point. The alloys with 5% molybdenum or tungsten melt above the melting point of titanium, those with 5% of iron, cobalt, or nickel at about 1500° C., that with 2% beryllium at about 1300° C., and the others at intermediate temperatures. The sintered cylinders were heated at 800° C. in a salt bath, hot-rolled as thin as possible, and examined micrographically. Alloys containing copper were relatively brittle, while those containing a metal of the tungsten or iron groups rolled readily. The presence of oxygen, sulphur, or carbon in the alloys resulted in severe embrittlement. Molybdenum, tungsten, and tantalum formed solid solutions, nickel, iron, cobalt, manganese, vanadium, and chromium a second constituent along the grain boundaries, and beryllium, aluminium, silicon, zirconium, and copper definite intermetallic compounds of a brittle nature.—A. R. P.

**\*On a New Phase in the System Iron-Zinc.** Jakob Schramm (*Z. Metallkunde*, 1937, 29, (7), 222–224).—A new phase  $\zeta$ , containing 6–6.5% iron, has been detected in iron-zinc alloys; it is formed by a peritectic reaction between  $\delta$  and liquid at 530° C., and exists in admixture with  $\eta$  in all alloys containing less than 6% iron below 419° C., and in admixture with  $\delta$  in alloys containing 6–7% iron below 530° C. Its existence was confirmed by thermal, magnetic, and X-ray analysis, and by micrographic examination.—A. R. P.

**\*Elastic Modulus and Damping as Functions of the State of the Metal.** (Förster and Köster). See p. 427.

**\*Yield-Strengths Corresponding to Small Percentages of Set.** G. F. Jenks (*Amer. Soc. Test. Mat., Preprint*, 1937, (June), 10–14).—Appendix to Report of Committee E-1 on Methods of Testing. The yield-strengths of typical ferrous and non-ferrous metals and alloys were determined, to ascertain whether the methods recommended (E 6–36) in *A.S.T.M. Standards*, 1936, (I), 861, and (II), 1429, should include some method of determining yield-strength for a very small amount of offset, of the order 0.003%. It is concluded that no revision of the methods of tests is necessary in cases where it is desirable to use such small offset values; A.S.T.M. specifications for metals do not cover materials requiring a very low % offset.—J. S. G. T.

†**[Electrical] Resistance of Alloys with Disordered and Ordered Arrangement of Atoms.** G. Borelius (*Proc. Phys. Soc.*, 1937, 49, (274), 77–95; discussion, 108–109).—B. suggests that resistance determinations have now an importance in metallography comparable with that of investigations by microscopes, X-rays, and thermal analysis. The following matters are reviewed: the resistance of dilute solid solutions of metals of groups 12–15 in copper, silver, and gold; the resistance of solid solutions of transition metals in copper, silver, and gold; the development of transformations from disordered to ordered atomic arrangements; continuous variation of degree of order; definitions of degree of order; anti-phase regions in partly ordered crystals; disorder produced by mechanical treatment; hysteresis between transitions and at the segregation process. A bibliography of 54 references is given.—J. S. G. T.

\*†A Study of the Order-Disorder Transformation. W. L. Bragg, C. Sykes, and A. J. Bradley (*Proc. Phys. Soc.*, 1937, 49, (274), 96-102; discussion, 108-109).—A summary is given of researches into the order-disorder transformation in alloys carried out at Manchester University and in the research laboratory of Metropolitan-Vickers, Ltd. Matters discussed are: the general nature of the transformation, dependence of order on temperature, energy changes due to formation of the superlattice, relaxation time, and influence of order on magnetic properties. It has been found that the measured energy of ordering in  $\beta$ CuZn alloys which depart from the equiatomic ratio is in accord with theoretical deductions. The existence of a superlattice in  $\beta$ -brass has been definitely proved. The alloy Cu<sub>3</sub>Pd appears to be tetragonal in the ordered state. A bibliography of 19 references is appended.—J. S. G. T.

†Age-Hardening Alloys. C. H. Desch (*Proc. Phys. Soc.*, 1937, 49, (274), 103-107; discussion, 108-109).—The attention of physicists is directed to effects observed in alloys and associated with age-hardening, the explanation of which has to be sought in the properties of the lattice and in changes of energy with temperature in lattices containing more than one kind of atom. The main characteristics of the phenomenon of age-hardening are briefly reviewed. It is suggested that the mechanism of age-hardening may not be very complex; the advice of physicists on the initiation of the process is desired. A bibliography of 16 references is appended.—J. S. G. T.

### III.—STRUCTURE

(Metallography; Macrography; Crystal Structure.)

(Continued from pp. 386-390.)

The Stereographic Projection. Charles S. Barrett (*Trans. Amer. Inst. Min. Met. Eng.*, 1937, 124, 29-58; and *Metals Technology*, 1937, 4, (5), 30 pp.; *A.I.M.M.E. Tech. Publ. No. 819*).—An elementary explanation of the principles and methods of stereographic projection, covering all the common applications in the field of metallography and physical metallurgy. 86 references are given.—P. W. R.

A New Method of Polishing Metallic Surfaces. — (*Metallurgist (Suppt. to Engineer)*, 1936, 10, 150-152).—See also *Met. Abs.*, 1936, 3, 75, 116, 202, 357; and this vol., p. 188. A description of the method of Jacquet (with references to published works), in which the metal specimen, after smoothing with emery, is finally polished by being treated as the anode in a suitable solution. For copper and brass pyrophosphoric acid electrolyte is used; for bronze orthophosphoric acid, and for lead a mixture of acetic and perchloric acids. The process appears less suitable for metals of duplex structure, and may give difficulty in the presence of non-metallic inclusions.—R. G.

Microscopic Imperfections in Metallic Crystals. Norman P. Goss (*Metal Progress*, 1937, 32, (1), 41, 80).—Structural imperfections within metallic crystals must be regarded as inherent characteristics of the material. G. considers that these characteristics are independent of cold-working, and that block-like displacements within the crystal can be produced during heat-treatment. X-ray diffraction studies reveal alterations in the appearance of the Laue spots if "block displacement" has occurred.—P. R.

\*Effect of Reversed Deformation on Recrystallization. Paul A. Beck (*Trans. Amer. Inst. Min. Met. Eng.*, 1937, 124, 351-364; discussion, 364-366; and *Metals Technology*, 1937, 4, (4), 14 pp.; *A.I.M.M.E. Tech. Publ. No. 818*).—A critical examination is made of previous work and conclusions on the rôle of bending as a factor affecting recrystallization. Experiments on cylindrical single-crystals of aluminium bent to different curvatures, annealed for

crystallization and afterwards etched, showed that the "consumptibility,"  $V$ , of the bent crystal does not depend on the orientation of the new crystals, and is practically independent of the duration or temperature of heating within limits; it is only very slightly decreased by previous recovery. ( $V = t/d$ , where  $t$  is the depth of the recrystallized layer and  $d$  is the diameter of the specimen. It is a measure of the tendency of the deformed crystals to be consumed by the growing new grains.) The effects of restraughtening similar bent specimens was then examined; for all orientations and for all deformation values examined,  $V$  for the restraughtened part was smaller than that for the crystal just bent to the same extent and not restraughtened. B. concludes that there is no direct physical relation between hardening (which is increased by restraughtening) and recrystallization. He explains also that the view of Polanyi, that "recrystallization power" depends on the bending of the slip lamellæ, is not really in contradiction to the view of Burgers, that it depends on the existence and quality of local curvatures. The term "recrystallization power" is used by Polanyi in the sense of consumptibility, while it is defined by Burgers as the number of nuclei and is measured by him as the number of grains.—P. W. R.

**Mechanical Analysis of Impact Brittleness.** N. Davidenkov and F. Wittmann (*Tech. Physics U.S.S.R.*, 1937, 4, (4), 308-324).—[In English.] The mechanical cause of the cold-brittleness of steels is discussed.—J. S. G. T.

**The Surface Structure of Solids.** The late (Sir) George Beilby (*Chem. and Ind.*, 1937, 56, (35), 773-778).—Consists of long extracts from the Hurter Memorial Lecture delivered by B. in 1903, in which he developed his now classical views on the superficial structure of solids, and presented his opinions regarding the nature of polish and the colour and lustre of metals. The paper is one of importance in the light of modern work on electron diffraction, and is very interesting reading.—J. S. G. T.

†**The Structure and Formation of Thin Films (Studied by Electron Diffraction).** G. I. Finch and S. Fordham (*Chem. and Ind.*, 1937, 56, (28), 632-639; discussion, 639).—Read at a Joint Meeting of the Society of Chemical Industry (London Section and Plastics Group) and the Oil and Colour Chemists' Association. The subject is briefly reviewed. A bibliography of 69 references is given.—J. S. G. T.

\*†**The Structure of Thin Metallic Films.** (Finch.) See p. 428.

†**Electron Diffraction and Surface Structure.** G. I. Finch (*Roy. Institution*, 1937, 10 pp.).—A lecture. The electron-wave theory of matter is briefly reviewed, and the investigation of polished metallic surfaces by its aid is briefly discussed. Quarrell and Finch find that a polish layer of copper exhibits a property characteristic of a liquid and not shared by the crystalline surface. The Beilby layer on some surfaces immediately recrystallizes on cessation of the polishing action. A thin coating of aluminium-magnesium alloy on an aluminium piston should lead to reduced wear in use.—J. S. G. T.

\***A Type of Crystalline Structure Observed in an Aluminium Wire Submitted to Alternate Torsion.** Raymond Jacqueson (*Compt. rend.*, 1937, 205, (5), 331-332).—Aluminium crystals up to 8 mm. in length in the form of wire were held for several hrs. at 550°-600° C. and submitted to alternating torsion. After a period of small transformations, a crushing rapidly occurred and produced an aggregate of crystallites whose directions varied by several degrees from that of the initial crystal. Examination by monochromatic rays showed a rotation and a preferred orientation of the crystallites, and these were further studied. The rotation varies with the amplitude of the alternating torsion imposed, and is always less than 10°. This experiment shows that a crystal can be transformed into an aggregate with a fibrous structure by means of a slight rotation of the crystallites about one of the crystallographic

axes, and enables a definite approach to be made to the question of the orientation of microcrystals in rolled or drawn metals.—J. H. W.

**\*X-Ray Illumination for Rendering Visible the Primary Structure [of Duralumin Type Alloys].** Hans Kostron and Eva Ruppel (*Z. Metallkunde*, 1937, 29, (5), 163–168).—X-Ray shadow-graphs of discs of cast, pressed, and forged alloys of the Duralumin type are reproduced to show the value of the methods for detecting segregations and the primary structure. By measurement of the intensities of the Cu-rich zones under standard conditions, it is possible to detect differences of 0.1–0.5% copper according to the thickness of the specimen.—A. R. P.

**\*X-Ray Studies on Electrodeposited Chromium and Gold.** Sudhendu Basu and M. Hussain (*Indian J. Physics*, 1937, 11, (3), 219–230).—Electrodeposited chromium and gold, studied by X-ray crystal analysis, exhibit some degree of correlation between current density and selective crystal orientation, and between hardness of the deposit and breadth of the X-ray diffraction lines. The photograms of chromium are characterized by the presence of certain new white lines. The gold deposits obtained from baths at various temperatures give diffraction lines interspersed with spots; the results confirm Bancroft's conclusion that decrease of bath temperature diminishes the crystal-grain size.—J. S. G. T.

**\*Studies Upon the Widmanstätten Structure. IX.—The Mg–Mg<sub>2</sub>Sn and Pb–Sb Systems.** Gerhard Derge, Arthur R. Kommel, and Robert F. Mehl (*Trans. Amer. Inst. Min. Met. Eng.*, 1937, 124, 367–378; and *Metals Technology*, 1937, 4, (6), 10 pp.; *A.I.M.M.E. Tech. Publ.* 820).—Mg<sub>2</sub>Sn with a CaF<sub>2</sub> type of lattice precipitates from its solid solution in the close-packed hexagonal Mg lattice as plates parallel to the {00.1}, {10.1}, and {10.2} planes of the matrix. It is possible to eliminate the formation of plates on the {10.1} and {10.2} planes by ageing at 250° C. rather than by slow cooling from 560° C. Three orientation relationships exist between these lattices:

- a. {111} // {00.1} and [110] // [10.0]
- b. {110} // {00.1} and [110] // [10.0]
- c. {111} // {00.1} and [110] // [11.0]

The different precipitation mechanisms are evidently related to the shearing processes that occur at the heat-treating temperature, and may have an important bearing on age-hardening processes. Body-centred rhombohedral Sb precipitates from face-centred cubic Pb as plates parallel to the {111} planes of Pb, probably by the relation {111}Pb // {001}Sb and [110]Pb // [100]Sb.—P. W. R.

**\*The Crystal Structure of Alloys of Zinc with the Alkali and Alkaline Earth Metals and of Cadmium with Potassium.** J. A. A. Ketelaar (*J. Chem. Physics*, 1937, 5, (8), 668).—X-ray crystal analysis reveals the same cubic structure for the alloys of zinc with sodium, potassium, calcium, strontium, and barium, and of cadmium with potassium. The sides of the elementary crystal cells have the respective values: NaZn<sub>13</sub>,  $a = 12.25_5 \pm 0.005$  A.; KZn<sub>13</sub>,  $a = 12.33_6 \pm 0.005$  A.; CaZn<sub>13</sub>,  $a = 12.13 \pm 0.005$  A.; SrZn<sub>13</sub>,  $a = 12.21_5 \pm 0.005$  A.; BaZn<sub>13</sub>,  $a = 12.33 \pm 0.005$  A.; KCd<sub>13</sub>,  $a = 13.78_5 \pm 0.005$  A. The number of atoms in the elementary cells was calculated to be 111, 113, and 111, respectively, for KCd<sub>13</sub>, NaZn<sub>13</sub>, and CaZn<sub>13</sub>. Each cadmium atom in KCd<sub>13</sub> is surrounded by 10 other cadmium atoms and one potassium atom. The compounds NaZn<sub>13</sub>, &c., may be considered as Hume–Rothery compounds with the typical ratio 27/14.—J. S. G. T.

**\*X-Ray Study of Coatings of Alloys Deposited in Galvanic Elements.** D. P. Zosimovich and M. V. Buchkovskii (*Zapiski Institutu Khemii, Ukrain'ska Akademia Nauk (Mem. Inst. Chem. Ukrain. Acad. Sci.)*, 1935, 2, 45–53; *Brit. Chem. Abs.*, 1936, [B], 842).—[In Ukrainian, with German summary.] Im-

mersion of zinc or copper electrodes in aqueous zinc sulphate or in molten zinc chloride results in deposition of zinc on copper, with formation of a brass coating; at the same time the e.m.f. decreases, to attain a final constant low level. The layers, in order of deposition, are  $\alpha$ -,  $\beta$ -, and  $\gamma$ -brass, deposition of each layer being associated with its characteristic potential.—S. G.

\***Transformations in Crystals with Lattice Distortions.** G. Tammann (*Z. anorg. Chem.*, 1937, 233, (3), 286-294).—Electrolytic iron and zinc show considerable lattice distortion, which starts to decrease on heating at 570° C. (iron) or 220° C. (zinc); at the same time the hardness and the rate of dissolution in acids decrease. In general, when a metal is electrodeposited at below the recovery temperature the deposit behaves like the cold-worked metal, but when it is deposited at above the recovery temperature (*e.g.* lead from warm solutions) the deposit behaves like the annealed metal; this statement also applies to metal films produced by condensation or by decomposition of volatile compounds. Thus, nickel deposited from carbonyl vapours at 60°-70° C. has similar properties to cast metal of the same quality after a 60% reduction by rolling, and gives a similar temperature-hardness curve on annealing, the hardness beginning to decrease at 400° C. and reaching that of annealed metal at 800° C.—A. R. P.

\***The Sensitivity of Metallic [Crystal] Superstructures to Processes of Working.** U. Dehlinger (*Z. Physik*, 1937, 105, (9/10), 588-594).—A quantitative explanation of the instability of atomic distribution in metallic crystal superstructures when the metal or alloy is subjected to some process of working, *e.g.* drawing, rolling, or hammering, is given in terms of Jones's electron theory (*Met. Abs.*, 1934, 1, 237). Illustrative examples of the theory are given by reference to the superstructures of the alloys CuPd and AuCu.—J. S. G. T.

\***"Round-About" Excitation (Umweganregung)—a Hitherto Unobserved Phenomenon of Mutual Action Associated with Space Lattice Interference.** M. Renninger (*Z. Physik*, 1937, 106, (3/4), 141-176).—It is well known that the Bragg law of reflection from a crystal lattice is apparently violated in the case where the phenomenon termed, in German, "Aufhellung" is observed. In this case, the reflected intensity is *weakened* in certain azimuths in which, in addition to the primary reflection, a secondary reflection is excited. This effect is, in general, of little practical significance. Attention is now directed to a phenomenon whereby the intensity of reflection may, in certain azimuths, be *increased* many-fold.—J. S. G. T.

\***Interstitial and "Berthollide" Compounds.** J. S. Anderson (*Chem. and Ind.*, 1937, 56, (35), 766-769).—A. applies the conception of the unit of crystalline structure to explain sphere of chemical combination, illustrated, first, by compounds, *e.g.* tantalum carbide, noteworthy for their pseudo-metallic characters, and secondly by cases, *e.g.* graphitic oxide or nickel oxide, in which the conception of stoichiometric composition must be abandoned as an unattainable limiting case. The structure and properties of the carbides and nitrides, graphitic compounds, and tungsten bronzes are briefly discussed. The chemical composition assumed by any compound is that which confers the greatest stability, *i.e.* the minimum potential energy upon its crystal structure.

—J. S. G. T.

†**The Metallic State and Intermetallic Compounds.** J. S. Anderson (*Chem. and Ind.*, 1937, 56, (30), 677-681).—Modern notions regarding the structure and properties of metals and alloys are briefly and interestingly reviewed. Among matters referred to are: the composition of intermediate phases, the Hume-Rothery rules, the nature of palladium hydride, and the electrical and magnetic properties of metals and alloys.—J. S. G. T.

**The Nature of Metals: a Modern Conception.** S. C. Clifford (*Coventry Eng. Soc. J.*, 1937, 18, (4), 112-129; discussion, 130-131).—Modern theory relating to the structure and properties of metals and alloys are interestingly



reviewed. C. discusses atomic theory, crystallization, mechanical properties, heat-treatment, and hot-working.—J. S. G. T.

#### IV.—CORROSION

(Continued from pp. 390-396.)

\*On the Reduction in the Rate of Dissolution of Aluminium in Hydrochloric Acid by Addition of Pyridine Derivatives. Ernst Jenekel and Fritz Woltmann (*Z. anorg. Chem.*, 1937, 233, (3), 236-256).—The inhibiting action of 23 derivatives of pyridine on the rate of dissolution of aluminium in 3*N*-hydrochloric acid was determined, and the results are tabulated for concentrations of 0.3 and 3.0 millimol./litre of inhibitor. The most effective reagents of those tested were acridine and 9-phenylacridine at the lower of the two concentrations, and 2-phenylquinoline at the higher; with 3.0 millimol./litre of the quinoline derivative the rate of evolution of hydrogen from the metal was only 1% of that without inhibitor present. In general, the inhibiting action increased rapidly with increase in the density of the hydrochloride of the base added, and is about 99% when this exceeds 1.35. Cathodic polarization of the metal still further reduces its rate of dissolution whatever inhibitor is present.—A. R. P.

\*Resistance of Light Metals [Aluminium Alloys] to Corrosion by Vegetable Tannins, Synthetic Tannins, Sulphite-Cellulose Waste Extract, and Different Curried Vegetable-Tanned Leathers. F. Stather and H. Herfeld (*Collegium*, 1937, 9-23; *Brit. Chem. Abs.*, 1937, [B], 475).—The maximum loss in weight by corrosion in tan liquors (3% of solid matter) at natural  $p_H$  values was obtained with cupriferous aluminium alloys. Loss in weight did not always accompany the appearance of corrosion. An aluminium-copper alloy was badly corroded, but without much loss in weight. An aluminium-magnesium-manganese alloy was the most resistant, and then an aluminium-magnesium alloy, but they were not so resistant as were copper and brass. Corrosion increased as the  $p_H$  of the tan liquors decreased, but not directly, and varied in order of increasing effect, thus: sulphited quebracho, oak bark, gambier, myrobalans, mangrove, sumac, oakwood, chestnut, sulphite-cellulose waste, synthetic tans (except Tannigan L.L.). The corrosion of aluminium alloys by curried leathers was independent of the grease. Maximum corrosion was shown by wet leather free from grease.—S. G.

\*Long Period Corrosion Tests with Gas Flasks of Light Alloys. N. Christmann (*Wärme*, 1936, 59, 719-723; *Brit. Chem. Abs.*, 1937, [B], 577).—Cf. *Met. Abs.*, this vol., p. 379. Gas flasks made of Lantal, Bondur, and Duralumin were filled with oxygen and carbon dioxide and subjected to mechanical tests after various periods of time. Provided that care was exercised in maintaining the internal varnish and external plating, little corrosion took place.—S. G.

Danger of Corrosion of Aluminium. F. Wehrmann (*Gas u.-Wasserfach*, 1936, 79, 803-804; *Brit. Chem. Abs.*, 1937, [B], 576).—Although pure aluminium has good corrosion-resistance, care should be taken that it is not in contact with other metals. Examples are given of severe corrosion of aluminium in the case of a tar separator and socket joints. The use of bitumen for protection is recommended.—S. G.

\*The Velocity of Oxidation of Cobalt. Germaine Chauvenet and Gabriel Valensi (*Compt. rend.*, 1937, 205, (5), 317-319).—The action of oxygen at 760 mm. pressure and at various temperatures on two specimens of cobalt was studied by a method previously described (*Bull. Soc. chim. France*, 1936, [v], 3, 1411). One specimen contained 99.14% and was not previously cast, the other contained 97.76% and was cast and drawn to a 5 mm. wire. The

compound  $\text{Co}_2\text{O}_3$  is formed at equilibrium below  $750^\circ\text{C}$ . and  $\text{CoO}$  above  $850^\circ\text{C}$ . Between these two limits, intermediate products are formed. The curves representing the time,  $t$ , and the square of the weight,  $w$ , of oxygen fixed per unit area follow the well-known parabolic law. They show that pure cobalt is more sensitive to oxidation than ordinary cobalt. The curve for  $\frac{w^2}{t} : \frac{1}{T}$ , where  $T$  is the absolute temperature, is a straight line, in accordance with Arrhenius' law. Between  $850^\circ$  and  $1100^\circ\text{C}$ ., the number of grams,  $v$ ,

of oxygen absorbed by  $S$  cm.<sup>2</sup> of ordinary cobalt is given by  $v = 8.51Se^{-\frac{8520}{T}} \cdot \sqrt{t}$ . The oxidation of nickel (*Met. Abs.*, 1935, 2, 516) requires a much greater activation energy than cobalt.—J. H. W.

**\*Effect of Sodium Hydroxide on Copper at High Temperatures.** A. S. Perry (*Indust. and Eng. Chem.*, 1937, 29, (6), 677).—Results of tests on insulated copper strips immersed in distilled water and also in solutions of sodium hydroxide from 0.1 to 2.0 grm./litre at 200 lb./in.<sup>2</sup> steam pressure, corresponding to a temperature of  $200^\circ\text{C}$ ., show that loss in weight increases with increase in sodium hydroxide concentration, up to the maximum ordinarily encountered in locomotive boiler operation, except that, in the neighbourhood of 1.5 grm./litre there is a sharp reduction in loss of weight. These results, however, did not solve the practical problem of the wastage of copper ferrules used as gaskets between the flues and the firebox flue-plate.—F. J.

**\*On the Corrosion of Beryllium Bronzes.** Haldun N. Terem (*Bull. Soc. chim. France*, 1937, [v], 4, (8/9), 1508–1524).—See also *Met. Abs.*, this vol., p. 290. Beryllium bronze is slightly more readily attacked by 1–10% nitric acid than is pure copper, but much less readily than aluminium bronze. In 1–10% hydrochloric acid beryllium bronze is about as resistant as copper, but not so resistant as aluminium bronze. Beryllium bronze resists 1–10% sulphuric acid, acetic acid, and sea-water very well, and is only slightly attacked by caustic soda, the 2.5% solution being the most corrosive.—A. R. P.

**\*Experimental Study of the Oxidation of Nickel Spherules.** Gabriel Valensi (*Bull. Soc. chim. France*, 1937, [v], 4, (4), 668–670).—Cf. *Met. Abs.*, this vol., p. 191. The results obtained for the rate of oxidation of nickel spherules of 0.8 and 1.6 mm. diameter at  $800^\circ$ – $1015^\circ\text{C}$ . show that the reaction at a constant temperature ( $T^\circ$  abs.) within these limits can be defined by the expression (deduced from theoretical considerations):  $F(m) = 2.471 - (1 - m)^{\frac{1}{2}} - 1.471(1 + 0.68m)^{\frac{1}{2}} = (38.14/r_0^2)e^{-22.420/T}t$ , where  $m$  is the fraction of nickel oxidized in time  $t$ , and  $r_0$  is the initial radius of the spherules. For powder  $F(m)$  varies linearly with  $t$  up to a certain value which is smaller the higher the temperature, and the slope of the graphs of  $F(m) = Ct$  is proportional to  $e^{-22.420/T}$ . Owing to the lack of sphericity of the particles in nickel powder, the factor  $38.14/r_0^2$  in the above expression does not hold good and should be replaced by a parameter  $\rho_0 = (38.14e^{-22.420/T}/c)^{\frac{1}{2}}$ , which can be considered as the radius of an equivalent sphere, and can be determined once for all by a single experiment. Substitution of  $\rho_0$  for  $r_0$  in the above expression then renders it of general applicability.—A. R. P.

**The Influence of Certain Ions on the Acid Corrosion of Nickel and Iron.** L. E. Sabinina and L. A. Polonskaia (*Zhurnal Prikladnoi Khimii (J. Applied Chem.)*, 1936, 9, (8), 1405–1415; *Brit. Chem. Abs.*, 1937, [B], 144).—[In Russian.] The corrosion of iron or nickel in 0.1N- and N-sulphuric acid, and in 0.1N-acetic acid is enhanced by cadmium and inhibited by mercury and lead salts. In particular, the corrosion of nickel is completely inhibited by 0.0004M mercuric sulphate.—S. G.

**\*On the Electrochemical Behaviour of Rhodium. II.—The Higher Degrees of Oxidation of Rhodium.** G. Grube and Bau-Tschang Gu (*Z. Elektrochem.*, 1937, 43, (6), 397–403).—See also *Met. Abs.*, 1934, 1, 136, and abstract below.

The electrolytic oxidation of trivalent rhodium sulphate in sulphuric acid solution results in a valency of the rhodium of about 4.5, and of trivalent rhodium perchlorate in perchloric acid solution of about 5.8. Hence, the presence of hexavalent rhodium is established. The oxide precipitates deposited from the approximately hexavalent solutions are deep blue and dissolve in excess alkali with a blue colour, while they are green when deposited from acid solutions in which the rhodium is tetravalent. Pure chemical oxidation of trivalent rhodium with chlorine or hypochlorite solutions from alkaline solutions yields oxide precipitates in which the rhodium is approximately hexavalent. The oxidation potential of the reaction:  $Rh^{III} + \oplus \longrightarrow Rh^{IV}$  in sulphuric acid solutions lies in the region of  $\epsilon_a = +1.40$  v., that of the reaction:  $Rh^{IV} + 2 \oplus \longrightarrow Rh^{VI}$  in the region of  $\epsilon_a = +1.46$  v. The higher oxides of rhodium are strong oxidizing agents in acid solutions.—J. W.

**\*On the Electrochemical Behaviour of Rhodium. III.—The Potentiometric Titration of the Higher Degrees of Oxidation of Rhodium in Acid Solution.** G. Grube and Karl Heinrich Mayer (*Z. Elektrochem.*, 1937, 43, (6), 404–406).—See also preceding abstract. Almost hexavalent oxidation products of rhodium are obtained by electrometric titration with ferrous ammonium sulphate solutions in the anodic oxidized solutions of rhodium perchlorate. The shape of the titration curve shows that in acid solutions, the tetravalent oxidation products of rhodium probably cannot, to any considerable extent, occur disproportionately according to the reaction:  $3Rh^{IV} \rightleftharpoons 2Rh^{III} + Rh^{VI}$ .

—J. H. W.

**Distribution of Tin in the Solid and Liquid Portions of Canned Vegetables.** C. Massatsch and E. Schneider (*Deut. Nahrungsm.-Runds.*, 1935, 61–62; *Brit. Chem. Abs.*, 1936, [B], 1124).—Canned asparagus and beans contained 83–124 and 104 mg. of tin per kg., respectively, the majority of which was present in the solids in insoluble forms.—S. G.

**Sugar as an Inhibitor of Corrosion in Canning.** H. C. S. de Whalley (*Chem. and Ind.*, 1937, 56, (25), 569–570).—de W. refers to results contained in *Dept. Sci. Indust. Res., Food Invest. Special Rep.* Nos. 40 and 44, relating to the inhibition of corrosion of tinplate containers by sugars, and suggests that such inhibitive effects may be due to the presence of traces of metals (copper, lead, manganese) which are removed or reduced considerably by refining operations.—J. S. G. T.

**The Theory of the Difference Effect.** M. Straumanis. W. J. Müller (*Z. Elektrochem.*, 1937, 43, (6), 406–407).—Polemical; see *Met. Abs.*, this vol., p. 49.—J. H. W.

**Determination of Corrosion-Resisting Properties of Metals and Alloys Against Flue-Gas Condensate.** F. P. Mueller (*Amer. Gas Assoc. Monthly*, 1936, 18, 35–37; *Brit. Chem. Abs.*, 1937, [B], 144).—The effects of the prolonged action of aqueous condensate, detained during the combustion of town's gas or natural gas, on various metals, e.g. sheet aluminium, copper, and lead, and on chromium–nickel–iron alloys, are shown in tables. Corrosion is probably due to sulphuric acid originating from the sulphur in the gas.—S. G.

**\*Electrode Potentials. Relation to Corrosion of Alloys and Metals in Lubricating Oils.** Frank Hovorka and John K. Anthony (*Indust. and Eng. Chem.*, 1937, 29, (8), 959–962).—Data are presented on the electrode potentials of various bearing metals and alloys in several lubricating oils. Potentials were found to start at about 110° C. in unstirred cells, and at about 70° C. in stirred cells. A voltage as high as 1.1 v. at 170° C. was found. Potentials varied considerably with temperature. A reversal of polarity was found in several instances. The possibilities of correlating these potentials and their variation with the problem of the corrosion of bearings are discussed. It is pointed out that much work is yet to be done before any definite conclusions may be reached.—F. J.

**Gasoline Tank Corrosion on Motor Boats.** A. E. Pew, Jr. (*Proc. 6th. Mid-Year Meeting Amer. Petrol. Inst., Sect. III, 1936, 17M, 20-21; C. Abs., 1936, 30, 7528*).—Corrosion in the petrol tanks of motor boats is due to the accumulation of moisture in the bottom and as vapour over the petrol. The corrosion is resisted by silicon bronze containing 3-4.5% silicon and a few % of tin and manganese. Tanks of copper-tin-silicon alloy have recently been installed in U.S. coast-guard patrol boats; silicon bronze has been used for tanks in U.S. cruisers for storing aeroplane fuel.—S. G.

**\*The Influence of Organic Materials on the Corrosion of Metals by Mineral Agents.** V. Pershke and A. Vinogradova (*Chim. et Ind., 1936, 36, (6), 1101-1108*).—Cf. *Met. Abs.*, this vol., p. 245. Experiments were conducted with steel, aluminium, lead, and copper, using sulphuric acid as the corroding agent in the case of iron and aluminium, acetic acid with lead, and ammonium sulphate with copper. In another series the action of hydrochloric acid on iron, copper, and aluminium was studied. The organic materials used were mainly those normally met in the dye industry, mainly nitrated aromatic compounds, though a number of aliphatic substances were also employed. In general, it was found that easily reducible organic compounds stimulated corrosion, whereas those not so reducible had more or less a protective effect, which is attributed to adsorption on the metal surfaces.—W. A. C. N.

**\*The Treatment of Calcium Chloride Brine with Sodium Dichromate for the Prevention of Corrosion.** E. W. Colbeck, S. W. Craven, and F. A. Fleming (*Proc. Brit. Assoc. Refrig., 1936-1937, 33, 52-71; and Ice and Cold Storage, 1936, 39, 180-181; C. Abs., 1936, 31, 990*).—The addition of 1.6 gm. per litre of sodium dichromate to calcium chloride brine, and subsequent maintenance of the alkalinity of the brine at approx.  $p_H$  8.5, cause a very definite and well-marked reduction in the corrosion of mild steel. The protection is estimated at 80-90%. Treatment with sodium dichromate had no detrimental effect on lead-coated ice cans. In practice, chromate treatment of brine was simple, and the correct concentration of chromate and alkalinity were maintained without difficulty.—S. G.

**Rôle of the Sulphate-Reducing Bacteria in Metallic Corrosion.** H. J. Bunker (*Proc. Brit. Assoc. Refrig., 1936-1937, 35, (1), 152-155*).—Refers to the corrosion of ferrous materials.—S. G.

**The Question of the Treatment of Cold-Water Supplies Within the Framework of the Four Years' Plan.** L. W. Haase (*Kleine Mitt. Vereins Wasser-, Boden- u. Lufthyg., 1937, 13, (1/5), 6-38*).—The purification of cold-water supplies and attention required by the distribution system in order that economy may be effected in the supply of water for all domestic and industrial purposes in Germany are interestingly discussed. Among the matters discussed are: incrustation of pipe systems, electrolysis of mains, erosion, purification plant, and protection of mains.—J. S. G. T.

**Corrosion of Non-Ferrous Metals Underground.** — (*U.S. Nat. Bur. Stand. Tech. Information Building Materials, 1937, (50), 6 pp.*).—Experimental data are given relating to the corrosion of non-ferrous metals, viz. lead, copper sheet, brass sheet, steel sheet, galvanized steel, and lead-coated steel sheet in various soils. The findings are based on results of Logan (*Met. Abs.*, this vol., p. 48). It is now possible, in some cases, to predetermine the corrosiveness of soils towards non-ferrous metals. No one metal or alloy is superior to all others for all soil conditions. With but few exceptions the rates of loss of weight and of penetration by pitting are less for non-ferrous metals than for ferrous metals in the same soil. Lead in some soils pits badly: the cause is not fully known. Lead-coated steel pipes corrode much faster after penetration than uncoated steel pipes. Copper and high-copper brasses corrode slowly in most of the soils studied. Brasses of lower copper content show a

distinct tendency to "dezincify." Pitting was, in general, less for galvanized steel than for non-galvanized steel.—J. S. G. T.

**Film Formation in Corrosion Processes.** W. H. J. Vernon (*Chem. and Ind.*, 1937, 56, (34), 751-755; discussion, 755-756).—Read at a joint meeting of the Society of Chemical Industry and the Oil and Colour Chemists' Association. Recent work on the protection of metals against corrosion by the formation of protective air-formed oxide films or precipitated hydroxide films is briefly reviewed. A *bibliography* of 21 references is appended.—J. S. G. T.

†**Fundamental Principles of Metallic Protection.** Ulick R. Evans (*J. B'ham. Met. Soc.*, 1937, 17, (2), 52-67; discussion, 67-79; and (summary) *Iron Coal Trades Rev.*, 1937, 134, (3602), 493-494).—The mechanism of corrosion and methods of protection are interestingly reviewed. The most obvious way of protecting metal is to cover it with an impervious coat, e.g. of glassy enamel or baked varnish. Films of oil-paint are rarely completely water-tight, and the success of an ordinary painting scheme usually depends on the presence of an inhibitive pigment, e.g. red lead. Paint usually fails to protect if applied to steel from which the scale has been only locally removed; the best plan is to remove scale entirely. Coatings of a more resistant metal usually only protect steel if continuous. Coatings of sprayed aluminium give admirable protection; paint coats applied to aluminium coatings retain their colours longer than if applied to bare steel. Phosphate coats are largely used below paint or enamel. Cathodic or anodic inhibitors can be added to water to make it non-corrosive. Anodic inhibitors are effective if added in sufficient quantity, but if added in insufficient quantity may accelerate perforation; cathodic inhibitors are generally free from this danger. Many interesting points are brought out in the discussion and E.'s reply. A *bibliography* of 19 references is given.—J. S. G. T.

[**The Prevention of Metallic Corrosion.**] K. C. Bailey (*Retardation of Chemical Reactions*, London: Edward Arnold & Co., 1937, 247-266; *Bull. B.N.F.M.R.A.*, 1937, (101)).—Chapter 18 (pp. 247-266) of B.'s book surveys the literature dealing with the effect of various substances in retarding the attack of metals by various corrosive media, and includes a discussion of inhibition.—S. G.

**Corrosion, Its Prevention and Investigation.** Tibor Vér (*Technika* (Budapest), 1937, 18, 111-115; *C. Abs.*, 1937, 31, 5740).—A general discussion. The behaviour of various metals towards corrosive agents is summarized in a detailed table.—S. G.

†**Recent German Advances in the Mechanism of Oxidation and Tarnishing of Metals.** Laurence E. Price (*Chem. and Ind.*, 1937, 56, (35), 769-773).—German work, carried out principally since 1933, on the mechanism of tarnishing of metals is briefly reviewed. The work is based principally on that of Wagner and his co-workers; an important conclusion is that the resistance of a metal to tarnishing and oxidation is closely connected with the value of the electrical resistance of the products of the change. The processes discussed are principally those in which the reaction rate of tarnishing approximates to a parabolic law. A *bibliography* of 42 references is appended.—J. S. G. T.

## V.—PROTECTION

(Continued from pp. 396-393.)

†**Report on Methods of Testing Oxide Coatings on Aluminium.** Junius D. Edwards (*Amer. Soc. Test. Mat. Preprint*, 1937, (June), 4-15; and *Met. Ind. (Lond.)*, 1937, 51, (4), 91-93).—Appendix II to Report of Committee B-7 on Light Metals and Alloys, Cast and Wrought. Some of the methods available for measuring the coating thickness (microscope, stripping), resistance to abrasion, and electrical breakdown voltage of oxide coatings on aluminium are reviewed. Close agreement is found between measurements of coating thick-

ness by the microscopic and stripping methods. Resistance to abrasion is substantially proportional to the thickness of coating. Extension of the work, and the development of new test methods, are necessary to meet the demands of industry, more especially as regards methods of control.—J. S. G. T.

**The Importance of the Surface Ennoblement of Aluminium and Aluminium Alloys by Electrolytic Oxidation by the Eloxal Process in the Four Years' Plan.** Walter Risch (*Metallwaren-Ind. u. Galvano-Tech.*, 1937, 35, (4), 86-89).—The properties of the Eloxal film are described, and some uses of Eloxal-treated aluminium in the aircraft, vehicle, machinery, electrical, and building industries are indicated.—A. R. P.

**The Anodic Oxidation of Aluminium.** A. Sarabia (*Anales soc. españ. fis. quim.*, 1936, 34, 323-331).—A review, with 40 references.—S. G.

**Analytical Notes on Tin Containers for Canning [Thickness of Tin].** (Lancefield.) See p. 457.

**Standard Specifications for the Use of Aluminium in Hot-Dip Galvanizing Baths.** Wallace G. Imhoff (*Amer. Metal Market*, 1937, 44, (44), 3, 5).—The following standard specifications for the aluminium content of galvanizing baths for various purposes are suggested, and reasons for selecting these percentages are discussed:—Baths for electrical conduit pipes and wire products 0-0.005%; for wrought iron pipes, structural steel, large hardware, range boiler tanks, and odd job work 0.01-0.03%; for small and medium-sized hardware articles 0.01-0.02%; for steel barrels and drums 0.03-0.04% when tin and cadmium are present and 0.01-0.02% when they are absent; for malleable and cast-iron fittings 0.005-0.01%.—A. R. P.

**Mechanism of "Peeling" of a Zinc Coating.** George F. Comstock (*Metal Progress*, 1937, 32, (2), 162-163).—C. comments on J. L. Schueler's statement (*Met. Abs.*, this vol., p. 344) that "galvannealed" zinc sheet is less brittle than ordinary galvanized material, as he considers a homogeneous layer of an iron-zinc compound unlikely to prove malleable. Examples of the effect of bending on galvanized and "galvannealed" wire are illustrated.—P. R.

**Electrolytic Zinc Methods Applied to Galvanizing.** (Tainton.) See p. 450.

**Corrosion-Fatigue of Wire Ropes [Prevention by Galvanizing].** H. Altpeter (*Glückauf*, 1936, 72, 1009-1010).—A. reviews the existing knowledge. The best preventive method is stated to be galvanizing.—S. G.

**The Finishing of Metals.** S. Wernick (*Architect. Rev.*, 1937, 81, (487), 279-280).—It is emphasized that architects should insist on metal finishes being produced to definite specifications. The important requirements in the cases of nickel and chromium plating and anodized coatings are explained.

—H. W. G. H.

**Applications of Metal Spraying in the Dyeing and Textile Industries.** N. H. Kitchen (*J. Soc. Dyers Colorists*, 1936, 52, 449-455; *Brit. Chem. Abs.*, 1937, [B], 130).—The spraying of metals (e.g. aluminium, zinc, lead, tin, nickel, cadmium, copper, silver, and gold) on to metal, wood, and fabric surfaces, and some of the properties of sprayed coatings, are described.—S. G.

**Surface Treatment by Welding Technique for the Prevention of Corrosion.** A. Matting (*Maschinenbau*, 1935, 14, 505-506).—Cf. *Met. Abs.*, 1936, 3, 81. M. discusses the production of non-porous, corrosion-resistant electric arc welds between steel stay bolts and copper alloy firebox parts.—S. G.

**Anti-Corrosive Paper.** Z. V. Utschastkina (*Mat. Zentr. Nautsch-Issledov. Inst. Bumashn. Prom.*, 1936, 21, 112-117; *Brit. Chem. Abs.*, 1937, [B], 332).—[In Russian.] Specifications are given for wrapping-paper designed to protect metal articles from corrosion and abrasion.—S. G.

**\*Uniting Rubber to Metals [Aluminium, Steel, and Brass-Plated Steel].** M. Faberov, A. Gorina, L. Zueva, V. Myagkova, and I. Grigor'eva (*Zhurnal Rezinovoi Promishlennosti (J. Rubber Ind.)*, 1936, (8/9), 900-911; *C. Abs.*, 1937, 31, 3332).—[In Russian.] *Thermoprene cement method.*—A thermoprene-

$C_6H_6$  cement (prepared from smoked sheet and *p*-phenolsulphonic acid) was coated on the surface of the metal. Unvulcanized rubber was then attached, steam-vulcanized at 138° C. for 15–60 minutes, and kept under 2 atm. air pressure until the temperature decreased to 70°–80° C. The adhesion to steel was 36 kg./cm.<sup>2</sup> and to aluminium 48 kg./cm.<sup>2</sup> Elevated temperatures decreased the adhesion, and at 90° C. it was 8 kg./cm.<sup>2</sup> *Brass method*.—Chemically-cleaned iron was brass-plated (10  $\mu$  thick), and coated with a  $C_6H_6$  cement of rubber-carbon black. The layer of rubber was then vulcanized on this coating. The adhesion of natural rubber was 61, that of synthetic sodium butadiene rubber 44, and of chloroprene rubber 85 kg./cm.<sup>2</sup>; the adhesion did not change from 20° to 110° C. *Latex-albumin cement method*.—The mixture used contained blood albumin 50–75 parts per 100 parts latex (Revertex), sulphur and accelerator, formaldehyde (a small proportion to make the cement more water-resistant), and a preservative. After coating, the metal was heated in air at 100°–125° C. for 10–30 minutes, the unvulcanized rubber attached and vulcanized in a press. The adhesion to steel of natural rubber was 45, that of synthetic sodium butadiene rubber 47, and of chloroprene rubber 0 kg./cm.<sup>2</sup> The adhesion to aluminium (its surface was chemically treated to increase the surface of the contact) was: natural rubber 49, synthetic sodium butadiene rubber 46 kg./cm.<sup>2</sup>. The adhesion did not change from 20° to 110° C.—S. G.

**Adhesion of Rubber to Metals.** M. Faberov (*Rev. gén. caoutchouc*, 1937, 14, (129), 9–13).—Abridged version of an article by F., Gorina, Zueva, Myagkova, and Grigor'eva (preceding abstract).—S. G.

**Corrosion and Metallic Pigments.** E. S. Greigov (*Peintures, pigments, vernis*, 1936, 13, 202–203; *C. Abs.*, 1937, 31, 5602).—The increasing use of aluminium paint in France for protection against corrosion is emphasized. The importance of a thin film of stearic acid on the surface of aluminium pigment particles, as a factor preventing settling, is pointed out.—S. G.

**Metallic Finishes.** H. W. Chatfield (*Paint Manuf.*, 1937, 7, 44–47, 83–84).—A review, dealing with the properties of paints containing metals and alloys as pigments.—S. G.

## VI.—ELECTRODEPOSITION

(Continued from pp. 398–400.)

**Chromium Plating from Non-Chromic Acid Solutions with Chromium Anodes.** M. Schlötter (*J. Electrodepositors' Tech. Soc.*, 1937, 13, 1–3).—The technique of chromium deposition from chromium chloride solutions is briefly discussed. The main difficulties encountered in the development of the system were: the supply of suitable anodes, and ensuring that the anodes would dissolve in the desired trivalent valency, and anodic formation of chromic acid avoided. Anodes were made from Thermit chromium and electrolytic chromium, melted in magnesia crucibles under high vacuum. Solution of the anodes in the trivalent form only was secured by superposition of a suitable a.c. upon a d.c. Pure chloride solutions are not suitable for plating. Deposits of high lustre or dark grey in colour can be obtained by varying the current density or  $p_H$  value. The useful current density exceeds 6 amp./dm.<sup>2</sup>, and the temperature should not exceed 20° C. The efficiency may increase to 30%. Some difficulties in providing suitable plant for the supply of superimposed d.c. and a.c. have still to be overcome.—J. T.

**\*Electrodeposition of Chromium from Potassium Dichromate Baths. I.—In Presence of Chloride and Acetate.** K. R. Rao and S. Husain (*J. Osmania Univ.*, 1935, 3, 9–15; *C. Abs.*, 1937, 31, 5687).—Electrolysis of a potassium dichromate solution produces a black deposit which contains very little chromium. A bath containing 0.5M potassium dichromate + 0.24M hydro-

chloric acid, with a current density of 0.4 amp./cm.<sup>2</sup>, produces dull white and uniform deposits of chromium after 15 minutes at an efficiency of 31.89%. If the concentration of hydrochloric acid is increased or decreased, a grey deposit is obtained. Increase in the length of time of electrolysis also produces grey and loose deposits. With higher or lower current densities, only loose deposits result. If acetic acid is added to the bath, bright, uniform, adherent deposits of chromium are obtained with a current density of 0.075 amp./cm.<sup>2</sup>, at an efficiency of 21.88%. When sodium acetate is added, satisfactory deposits are obtained in  $\frac{1}{2}$  hr. with a current density of 0.2 amp./cm.<sup>2</sup> and an efficiency of 1.16%. Of the above-mentioned baths, the acetic acid bath gives the best yield and the most satisfactory deposits.—S. G.

**\*Theory of Chromium Plating.** Erich Müller (*Z. Elektrochem.*, 1937, 43, (6), 361-376).—See *Met. Abs.*, 1934, 1, 352-353. The theory of chromium plating is further discussed. Experiments showed the inhibiting of the foreign effect by the evolution of hydrogen, and a considerable difference between the behaviour of platinum and gold electrodes in cathodic polarization both in SO<sub>4</sub>-free and SO<sub>4</sub>-containing solutions. The theory of Weiner (*Met. Abs.*, 1936, 3, 366) is recapitulated and criticized.—J. H. W.

**\*X-Ray Studies on Electrodeposited Chromium and Gold.** (Basu and Hussain.) See p. 439.

**The Production of Electrotypes.** C. E. Ronneberg (*J. Chem. Education*, 1937, 14, (7), 303-310).—Describes the advantages of electrotyping and the various operations by which electrotypes are made, and discusses the method and mechanism of copper deposition.—J. H. W.

**\*Alkaline Plating Baths Containing Organic Amines. I.—Copper Plating from Solutions Containing Diethylenetriamine.** C. J. Brockman (*Trans. Electrochem. Soc.*, 1937, 71, 255-258; discussion, 258-261).—See *Met. Abs.*, this vol., p. 197.—S. G.

**\*Alkaline Plating Baths Containing the Ethanolamines. V.—Copper Plating from Diethanolamine Solutions.** C. J. Brockman and J. B. Whitley (*Trans. Electrochem. Soc.*, 1937, 71, 251-254; discussion, 258-261; and (summary) *Metallwaren-Ind. u. Galvanotech.*, 1936, 34, (12), 229-230).—See *Met. Abs.*, this vol., p. 197.—S. G.

**\*Electrolytic Deposition of Copper on Aluminium After Previous Chemical Oxidation.** Werner Helling and Heinrich Neunzig (*Aluminium*, 1937, 19, (5), 302-305).—The articles are degreased by immersion for 10 minutes in cold 10% caustic soda solution, followed by a rinse in 2% hydrochloric acid. The oxide film is then produced by immersion for 15 minutes at 95° C. in a sodium carbonate solution containing sodium chromate or sodium metavanadate; the articles are then washed well in cold water and dried. The copper-plating bath contains copper sulphate crystals 150, 65% sulphuric acid 60, and gelatin 0.01-0.1 grm. per litre; plating is carried out at 20°-25° C. using 1-1.1 amp./dm.<sup>2</sup> for 60-90 minutes. During electrolysis, the oxide film is gradually dissolved and replaced by a firmly adherent deposit of copper, which shows no sign of flaking or cracking when the metal is subjected to the Erichsen test, bent through 180°, or heated to 400° C. in air. Using 99.5% aluminium as basis metal, the minimum porosity of the plate is obtained when the aluminium is previously annealed at 550° C. for 90 minutes, and the maximum when the metal is plated in the hard-rolled state.—A. R. P.

**Electrolytic Coating With Lead Without Immersing in the Electrolyte. [Electro-Rubbing.]** N. P. Fedotieff, B. P. Artamonoff, and N. J. Rasmcova (*J. Electrodepositors' Tech. Soc.*, 1937, 13, 15 pp. (Paper No. 11)).—By "electro-rubbing" is meant the electrodeposition of a metal by wrapping the anode with a cloth impregnated with electrolyte and rubbing it on the cathodic surface. The technical possibilities of obtaining electrodeposited lead coatings by "electro-rubbing," using a special stirred anode wetted with electrolyte



are determined. The anode must be of lead because separation of lead peroxide occurs at an insoluble anode, producing exhaustion of the electrolyte. The most suitable electrolyte is found to be lead borofluoride solution of the composition given by Blum, *viz.* basic lead carbonate, 142 grm./litre; hydrofluoric acid (100%), 120 grm./litre; boric acid, 106 grm./litre; gluc, 0.2 grm./litre. With this electrolyte, very high current densities can be employed both at anode and at cathode. Lead coatings produced by "electro-rubbing" are found to be quite satisfactory in respect of resistance to corrosion, adhesion, and appearance.—J. S. G. T.

\***The Electrodeposition of Manganese from Aqueous Solutions. II.—Sulphate Electrolytes.** W. E. Bradt and H. H. Oaks (*Trans. Electrochem. Soc.*, 1937, 71, 279–285; disc., 285–286).—See *Met. Abs.*, this vol., p. 198.—S. G.

\***Electrodeposition of Manganese, Using Insoluble Anodes.** Colin G. Fink and M. Kolodney (*Trans. Electrochem. Soc.*, 1937, 71, 287–298; discussion, 299–300).—See *Met. Abs.*, this vol., p. 197.—S. G.

**Heavy Nickel and Chromium Deposition in England. Recovery of Excessively Worn Machine Parts.** Charles F. Bonilla (*Trans. Electrochem. Soc.*, 1937, 71, 263–274; discussion, 274–278; and *Met. Ind. (Lond.)*, 1937, 50, (21), 585–588).—See *Met. Abs.*, this vol., p. 198. A bibliography of 19 references is appended to the discussion, dealing with the heavy plating of nickel, chromium, and iron.—S. G.

\***Deposition of Bright Nickel Coatings on Unpolished Surfaces.** G. S. Vozdvishenski and R. Z. Suleimanova (*Zhurnal Prikladnoi Khimii (J. Applied Chem.)*, 1936, 9, (8), 1416–1422).—[In Russian.] Bright nickel coatings are obtained on unpolished iron surfaces by electrolysis at 20°–25° C., with a current density of 8–10 amp./dm.<sup>2</sup>, and with an electrolyte containing nickel sulphate 245, boric acid 16, and cadmium chloride 0.3 grm. per litre, at  $p_H$  4.5–5.5. Under these conditions the coating has a high hydrogen content, leading to internal tensions, as a result of which the nickel is deposited in very small crystallites.—S. G.

\***Nature and Mechanism of Formation of Streaky Nickel Deposits.** G. S. Vozdvishenski and I. A. Makolkin (*Zhurnal Prikladnoi Khimii (J. Applied Chem.)*, 1936, 9, (8), 1423–1426).—[In Russian.] See also preceding abstract. Striated nickel deposits are obtained when the [Zn<sup>++</sup>] of the electrolyte is > 0.47% at 20° C., or > 0.65% at 60° C. The effect is ascribed to deposition of zinc-nickel alloy at the cathode, as a result of the depolarizing effect of nickel on the process of deposition of zinc. At the same time the  $p_H$  of the solution around the cathode increases, leading to the formation of positively-charged particles of Ni(OH)<sub>2</sub>, which are also deposited on the cathode.—S. G.

\***A Study of Electrodeposits Containing Nickel and Sulphur.** Wm. T. Young and H. Kersten (*Trans. Electrochem. Soc.*, 1937, 71, 225–229; discussion, 229–231).—See *Met. Abs.*, this vol., p. 198. In the discussion, R. Brill claims priority, which Y. and K. admit, having overlooked B.'s work (*Ergeb. tech. Röntgenkunde*, 1931, 2, 122; *Z. Krist.*, 1930, 75, 226; *Angew. Chem.*, 1936, 48, 787).—S. G.

\***Electrodeposition of Silver from Non-Aqueous Solutions Containing Aluminium Bromide.** V. A. Plotnikov, D. P. Zosimovich, and E. I. Kirichenko (*Zapiski Institutu Khimii, Ukrain's'ka Akademia Nauk (Mem. Inst. Chem., Acad. Sci. Ukrain. S.S.R.)*, 1937, 4, 15–27; *C. Abs.*, 1937, 31, 5688).—[In Ukrainian.] At 0.5–1.5 v., silver deposits from silver bromide or silver chloride-aluminium bromide solutions in toluene or xylene in a compact, finely crystalline layer. The optimum concentration of aluminium bromide is 0.25 to 0.33 mole per mole of solvent; current density 0.3 amp./dm.<sup>2</sup>. Deposits up to 0.1 mm. were as firm as, and smoother than, those from a cyanide bath. The work must be carried out in the absence of atmospheric moisture. Direct deposition of iron was not accomplished.—S. G.

**\*On Black Silver.** A. Glazunov and E. Drescher (*Chem. Listy*, 1936, 30, (19/20), 260-264).—The formation of black silver was studied by electrolysis under the microscope by an improved method. The authors discuss conditions influencing the formation of black silver, and show on diagrams the individual phases of increase of the cathodic deposit from a 1% solution of silver nitrate maintaining a constant intensity of current of 0.15 m. amp. For the first 5 seconds of current flow the deposit was greyish-white, then black silver is formed abruptly, having the appearance of a loose black or brown-black mass without metallic lustre; beginning with the 25th second the deposit assumes a new aspect, the formation of black silver having ceased. By addition of ammonia to the solution, the authors succeeded in obtaining a relatively stable form of black silver; microscopic study showed that even the darkest amorphous-looking parts of the mass had from the very moment of formation a fine crystalline structure. The stability of black silver and the circumstances under which it turns into white silver are discussed. An explanation of the existence of black silver can be only given by an X-ray study. The authors suppose a change of space lattice taking place whereby the size of the elementary crystals and the number of atoms contained in them would remain unchanged, *i.e.* only the mutual situation of the atoms is supposed to undergo a change.—O. Q.

**Black Silver Deposits.** O. K. Kudra (*Zapiski Institutu Khemii, Ukrain's'ka Akademia Nauk (Mem. Inst. Chem., Acad. Sci. Ukrain. S.S.R.)*, 1937, 4, 48-56; *C. Abs.*, 1937, 31, 5688).—[In Ukrainian.] Black silver deposits at high current densities are due to deposition of complex double ions, as a result of rapid depletion of simple silver ions.—S. G.

**Electrolytic Tantalum Plating of Metals in Molten Salt Mixtures.** V. A. Plotnikov and N. N. Gratsianskii (*Zapiski Institutu Khemii, Ukrain's'ka Akademia Nauk (Mem. Inst. Chem., Ukrain. Acad. Sci.)*, 1935, 2, 245-249; *C. Abs.*, 1937, 31, 4599).—[In Ukrainian, with German summary.] Tantalum coatings 0.01-0.03 mm. thick are electrodeposited on copper or iron from 1 : 1 TaCl<sub>5</sub>-NaCl at 400° C., or from mixtures of TaCl<sub>5</sub> 5.5, AlCl<sub>3</sub> 67.5, and NaCl 27%, at 225°-250° C. (0.5 amp./dm.<sup>2</sup>; tantalum anode). Tantalum-plated iron is resistant to the action of 20% hydrochloric acid.—S. G.

**\*The Electrodeposition of Tin from Acid Sulphate Solutions.** A. W. Hother-sall and W. N. Bradshaw (*J. Electrodepositors' Tech. Soc.*, 1937, 12, 113-128; also *Tech. Publ. Internat. Tin Res. Develop. Council, Series A*, 1937, (56), 16 pp.; and *Met. Ind. (Lond.)*, 1937, 51, (8), 187-192).—The effects of various addition agents to acid stannous sulphate baths was investigated with regard to covering power and the coherence and freedom from porosity of the deposit. The most successful agents were found to be hydroxy aromatic compounds, such as β-naphthol and resorcinol, in conjunction with a protective colloid, such as gelatin or lysalbic acid. Cresol sulphonic acid is also added to stabilize the solution.—H. W. G. H.

**\*Metals Codeposited with Tungsten from the Alkaline Tungsten Plating Bath.** M. L. Holt (*Trans. Electrochem. Soc.*, 1937, 71, 301-309; discussion, 309-311).—See *Met. Abs.*, this vol., p. 294.—S. G.

**Electrolytic Zinc Methods Applied to Galvanizing.** U. C. Tainton (*J. Amer. Zinc Inst.*, 1937, 18, 42-48; discussion, 48-56; and *Met. Ind. (Lond.)*, 1937, 51, (7), 165-166).—A process is described for plating iron wire and sheet with a heavy, high-purity coating of zinc. The wire or sheet is cleaned by making it the cathode in a bath of fused caustic soda and passes to plating cells containing an electrolyte of zinc sulphate, which is obtained by leaching roasted zinc concentrate with return electrolyte from the cells, and purifying. In this way, the production and electrodeposition are combined in the one process.—H. H.

**The Zinc-Plating of Iron in Acid Electrolytes.** L. B. Adamovitch and A. M. Guiva (*Zhurnal Prikladnoy Khemii (J. Applied Chem.)*, 1937, 10, (2), 270-282; *Brit. Chem. Abs.*, 1937, [B], 579).—[In Russian.] Iron articles are

zinc-plated in a bath containing zinc sulphate 200, sodium sulphate 50, zinc chloride 20, sulphuric acid 5, starch 3, mercuric sulphate 0.2, and water 1000 grm., at  $p_H$  2.1, with a current density of 3 amp./dm.<sup>2</sup>, at room temperature. The iron surface should be pickled in 15% hydrochloric acid, or 20% sulphuric acid, and degreased electrolytically in 10% sodium hydroxide.—S. G.

\***X-Ray Study of Coatings of Alloys Deposited in Galvanic Elements.** (Zosimovich and Buchkovskii.) See p. 439.

**Basic Considerations on Cyanide Plating Baths.** Richard Springer (*Metallwaren-Ind. u. Galvano-Tech.*, 1937, 35, (15), 312–314).—The importance of keeping a correct "free cyanide" content in brass, copper, zinc, and silver cyanide plating baths, and of occasionally freezing out excess of sodium carbonate produced by hydrolysis of the cyanide, is emphasized.—A. R. P.

**Blister Pits in Electrodeposits.** Michel Cymboliste and Jean Salauze (*Trans. Electrochem. Soc.*, 1937, 71, 233–246; discussion, 246–250).—See *Met. Abs.*, this vol., p. 199.—S. G.

## VII.—ELECTROMETALLURGY AND ELECTROCHEMISTRY

(Other than Electrodeposition.)

(Continued from pp. 401–402.)

**Electrolytic Preparation of Ferrochromium.** L. N. Goltz and V. N. Kharlamov (*Zhurnal Prikladnoi Khimii (J. Applied Chem.)*, 1936, 9, (11), 1951–1964; *Brit. Chem. Abs.*, 1937, [B], 355).—[In Russian.] 1 : 4 iron–chromium is obtained in 30% yield by continuous electrolysis (10–15 amp./dm.<sup>2</sup>, at 20°–40° C.) with a flowing electrolyte, maintained at a constant concentration of 1.6*M*-(chromium + iron) sulphates (chromium : iron = 15 : 1) and 1% of sulphuric acid.—S. G.

\***Electrolysis in Phosphate Melts. III.—The Electrolysis of Molybdc Acid in Molten Phosphoric Acid and Molten Alkali Phosphates.** Hellmuth Hartmann and Ullrich Conrad (*Z. anorg. Chem.*, 1937, 233, (3), 313–320).—Electrolysis of molybdc acid in phosphate melts having a P<sub>2</sub>O<sub>5</sub> : Na<sub>2</sub>O ratio of more than 1 yields at low current densities only phosphates of ter- or quadrivalent Mo, and at high current densities the phosphide MoP. In more alkaline melts the dioxide is produced at low temperatures, but at above 700° C. and at high current densities deposits of pure Mo can be obtained with a current yield of more than 60%. No  $\beta$ -modification of the metal analogous to  $\beta$ -tungsten could be obtained.—A. R. P.

\***The Electrode Potential of Thin Films of Zinc on Platinum.** D. P. Mellor and H. Mulhall (*J. Proc. Roy. Soc. N.S. Wales*, 1937, 70, 332–337; *C. Abs.*, 1937, 31, 4600).—A thin film of zinc was plated on platinum by short-circuiting the cell Zn, ZnSO<sub>4</sub> (aq.), Pt for 5 days. The initial e.m.f. was 1.158 v. and decreased to 0.050 v. On the assumption that the accessible surface was 2.1 times the apparent surface, the thickness of the film was calculated to be  $1.45 \times 10^{-5}$  cm., which is greater than the value obtained by other investigators (see Nichols, *Met. Abs.*, 1935, 2, 657). On open circuit the e.m.f. returned to almost its original value. The method of short-circuiting is not so well adapted as direct plating out for studying the behaviour of thin films.—S. G.

\***Electrokinetic Potentials at Metal Surfaces.** J. F. Chittum and Herschel Hunt (*Trans. Electrochem. Soc.*, 1937, 71, 207–217; discussion, 217–223).—See *Met. Abs.*, this vol., p. 200.—S. G.

**The Electrochemical Behaviour of Metals Having Two or More Valencies.** I. R. Piontelli (*Gazz. chim. ital.*, 1936, 66, 787–791; *C. Abs.*, 1937, 31, 4600).—A theoretical discussion. Electrochemical and chemical oxidation reactions of a metal which gives cations of two different valencies are characterized under ordinary conditions by differences in the corresponding normal electrolytic potentials. These differences depend, both in magnitude and sign, on variations in the Gibbs function during vaporization and ionization of the

metal, and passage of the two ions from the gaseous phase into the solution. They are related, therefore, to the atomic constitution of the metal, and also to the properties of the solvent and other ions which the latter contains.—S. G.

**\*On the Theory of Passivity Phenomena. XXXI.—On the Passivity of Chromium.** W. J. Müller and J. Z. Briggs (*Monatshefte*, 1937, 70, (2), 113–145).—Chromium is always coated with an oxide film; on passive chromium the “free” surface is of the order of  $10^{-3}$  cm.<sup>2</sup>/cm.<sup>2</sup> of surface, but on cathodic treatment or self-activation in hydrochloric acid it is increased to about  $3 \times 10^{-2}$  cm.<sup>2</sup>/cm.<sup>2</sup>, whereas on self-passivation, or after anodic polarization, it is decreased to  $10^{-1}$  cm.<sup>2</sup>/cm.<sup>2</sup>. Both active and passive chromium dissolve in sulphuric acid as divalent ions when the anode potential does not exceed 0.5 v., as di- and trivalent ions when the potential is 0.5–1.0 v., and as ter- and hexavalent ions when the potential exceeds 1.2 v. With more than 2 v. at the anode, oxygen is also evolved at the oxide film. This behaviour is in accord with the pore theory of anodic passivity, according to which the metal dissolves at a higher valence when the coating film potential is greater than the reversible potential of dissolution at a lower valence step. From the behaviour of active chromium in sulphuric acid at low potentials, it is concluded that the pores are irregular in size, with a mean diameter of  $40 \times 10^{-8}$  cm.; this would account for the furnishing of di- and trivalent ions at potentials of 0.5–0.8 v.

—A. R. P.

**\*Influencing Metal Passivity by Ultra-Resonance (Ultraschall).** Gerhard Schmid and Lothar Ehret (*Z. Elektrochem.*, 1937, 43, (6), 408–415).—Examples are given of the action of intensive ultra-resonance on passive metals and on the passivating and activating processes. They show that the mechanical passivity cover film can be removed or inhibited by ultra-resonance both in the currentless state (lead in sulphuric acid) and in anodic polarization (lead in sodium carbonate solution). The cover film is torn off and dispersed in the liquid. With aluminium, on the other hand, the formation of an anodic protecting layer is assisted by ultra-resonance, even from the beginning. It is surprising that the passivity of an iron anode in dilute caustic soda solution is also not prevented, or even retarded, by intense ultra-resonance. It thus appears that a mechanically-formed cover film plays no part. The chemical passivity of iron and chromium in concentrated nitric acid in the currentless state can be prevented by ultra-resonance, but great intensity is necessary for chromium. On the other hand, the anodic passivation of nickel in weakly acid sodium sulphate solutions is accelerated by ultra-resonance. An explanation of the effect of ultra-resonance on chemical passivity is not yet possible.—J. H. W.

**\*Storage Battery Life Tests. I.—Laboratory Life Testing. II.—Service Life Testing.** J. E. Hatfield and H. R. Harner (*Trans. Electrochem. Soc.*, 1937, 71, 583–596, 597–603; disc., 604–609).—See *Met. Abs.*, this vol., p. 251.—S. G.

**\*The Polarization Capacity of the Mercury Electrode.** T. Borissowa and M. Proskurnin (*Acta Physicochimica U.R.S.S.*, 1936, 4, (6), 819–828).—[In German.] The capacity ( $C$ ) of the Helmholtz double layer at the surface of a mercury electrode in contact with solutions of (1) hydrochloric acid, (2) potassium chloride, and (3) caesium chloride was determined. In all cases a maximum value of  $C$  was found to occur in the region of polarization voltage, ( $\phi$ ), —0.4 to —0.5 v. Thereafter the value of  $C$  decreases with increase of  $\phi$ , and finally increases again.—J. S. G. T.

**\*On the Platinum Electrode. II.—The Adsorption Characteristics of the Platinum Electrode.** A. Slygin, A. Frumkin, and W. Medwedowsky (*Acta Physicochimica U.R.S.S.*, 1936, 4, (6), 911–928).—[In German.] The relation between the potential of a platinum electrode and the adsorption of electrolyte thereat was determined in a number of aqueous solutions of inorganic acids, bases, and salts, and the results are discussed in association with measurements of the electrostatic capacity of the electrode.—J. S. G. T.

\***Electrolytic Etching Process [for Copper Half-Tones].** M. Nagano and S. Fujihara (*Research Bull. Govt. Printing Bur. Tokyo*, 1935, Rept. 4, 20 pp.; *C. Abs.*, 1937, 31, 5278).—[In Japanese.] Electrolytic etching in 2.5*N*-potassium nitrate + *N*-acetic acid was compared with chemical etching, and found satisfactory.—S. G.

## IX.—ANALYSIS

(Continued from pp. 402–404.)

**Micro-Detection of Aluminium, Magnesium, and Zinc with 1-Aminoanthraquinone-2-carboxylic Acid.** J. V. Dubský and M. Hrdlička (*Mikrochem.*, 1937, 22, (1), 116–118).—A 0.01*N*-solution of the K salt of the reagent gives a dark red precipitate with Al, Mg, and Zn in neutral chloride solution, the sensitivity of the reactions being 1 : 220,000, 1 : 83,000, and 1 : 3100, respectively.—A. R. P.

**Reaction for Cadmium.** P. G. Popov (*Ukrainski Khimichni Zhurnal (J. Chim. Ukraine)*, 1934, 9, 307–309; *Brit. Chem. Abs.*, 1935, [A], 950).—[In Ukrainian.] 1 c.c. of solution is heated with 0.5 gm.  $\text{NH}_4\text{Br}$  and 1.5 c.c. of conc.  $\text{H}_2\text{SO}_4$  to evolution of  $\text{SO}_3$ ,  $\text{H}_2\text{O}$  is added to 8 c.c., 0.5 gm. of Fe powder is added, the suspension is filtered after 30 seconds, an equal volume of  $\text{H}_3\text{PO}_4$  added to the filtrate, and  $\text{H}_2\text{S}$  is passed, when a yellow precipitate is obtained with  $\leq 0.9$  mg. of Cd. Other metals do not interfere.—S. G.

\***On the Reaction Between Copper Salts and Hydrobromic Acid and Its Application to the Microchemical Detection of Copper.** Selim Augusti (*Mikrochem.*, 1937, 22, (2), 139–145).—[In Italian.] The solution to be tested is evaporated to dryness, and the dry residue taken up in a few drops of dilute HCl; the solution is poured carefully on to a mixture of 1 c.c. of conc.  $\text{H}_2\text{SO}_4$  and 2 c.c. of conc. HBr; in the presence of Cu a violet ring appears at the interface. Hg, Ag, Pb, Cd, and  $\text{Fe}^{+++}$  must first be removed.—A. R. P.

\***A Reaction for Manganese.** Einar Jensen (*Z. anal. Chem.*, 1937, 109, (5/6), 178–181).—The HCl solution (1 c.c.) is treated with 2 c.c. of conc. HCl, 4 c.c. of a 1 : 1 mixture of ether and HCl, and 1 crystal of  $\text{KClO}_3$ ; in the presence of Mn an intense green colour develops. By evaporating a solution to a few drops and using proportionate amounts of reagents, as little as 0.005 mg. of Mn can be detected.—A. R. P.

\***Surface Effects of the Platinum Metals on Silver Assay Beads.** E. C. Forbes and F. E. Beamish (*Indust. and Eng. Chem. (Analyt. Edn.)*, 1937, 9, (8), 397–400).—The appearance of the surface of cupelled Ag beads containing Pt metals depends on the nature of the metal present, on the cupelling temperature, and on the rate of cooling, and the various Pt metals all interfere with each other's effects, so that it is impossible, without a great deal of experience in this type of work, to say definitely from the appearance of the bead which metals are present, or even whether the bead contains any Pt metal at all. In all cases, chemical tests are essential for a reliable detection.—A. R. P.

\*[Microchemical] **Separation and Detection of Impurities in Lead.** I.—Tin. Beverly L. Clarke, Leland A. Wooten, and J. D. Struthers (*Indust. and Eng. Chem. (Analyt. Edn.)*, 1937, 9, (7), 349–351).—An apparatus is described by means of which it is possible to dissolve 25 gm. of Pb in HCl with the aid of a little  $\text{HNO}_3$ , and to filter off the  $\text{PbCl}_2$  precipitate as it is formed; the whole operation is carried out automatically, and requires no attention when once started. The resulting chloride solution contains only a little Pb: it is treated with  $\text{FeCl}_3$  and  $\text{NH}_4\text{OH}$  to separate the Sn, the precipitate dissolved in HCl, the solution reduced with granulated Pb, and the  $\text{SnCl}_2$  titrated with dilute I solution in the usual way.—A. R. P.

**Rapid Analysis of Metals and Alloys.** G. T. Michaltschischin (*Bull. Sci. Univ. Kiev*, 1936, 2, 85-96; *Brit. Chem. Abs.*, 1937, [B], 575).—Micro-reactions for the detection of Cu, Mn, Fe, Al, Pb, Zn, Cr, and Ni in alloys are described.

—S. G.

**\*The Precipitation of Metals with 8-Hydroxyquinoline (Oxine).** II.—The Effect of  $p_H$  on the Precipitation of Cadmium, Tungsten, and Uranium from Acetate Solutions. H. Ronald Fleck (*Analyst*, 1937, 62, (734), 379-383).—In buffered acetate solutions  $Cd(C_9H_6ON)_2$  is precipitated at  $p_H$  5.66-14.58,  $WO_3(C_9H_6ON)_2$  at  $p_H$  4.95-5.65 and  $UO_2(C_9H_6ON)_2 \cdot C_9H_6ON$  at  $p_H$  5.71-9.81. Hence, by suitable adjustment of the  $p_H$  it is possible to effect the following separations: W from Cd, U from Cd, U from W, and U from Mo. Details of these separations are given.—A. R. P.

**\*Separation of Gold from Tellurium and Selenium.** J. Seath and F. E. Beamish (*Indust. and Eng. Chem. (Analyt. Edn.)*, 1937, 9, (8), 373-374).—The chloride solution is adjusted to 1.2N-HCl, and the Au precipitated by boiling with hydroquinone. In the filtrate Te is separated with  $N_2H_4$  and  $SO_2$  in 4N-HCl, and Se with  $SO_2$  in 9N-HCl. Both precipitates are dried at 105° C. in  $CO_2$  for weighing.—A. R. P.

**\*On the Separation of Uranium, Zirconium, and Titanium from Manganese, Cobalt, and Nickel by Means of Pyridine.** E. A. Ostroumov (*Ann. Chim. analyt.*, 1937, [iii], 19, (4), 89-93).—The hot solution containing an excess of  $NH_4^+$  salts is treated with  $C_5H_5N$  (20% solution); Mn, Co, and Ni remain in solution.—A. R. P.

**\*On the Separation of Zinc from Cobalt, Nickel, and Manganese by Means of Hydrogen Sulphide, and the Ultimate Precipitation of Zinc by Anthranilic Acid.** E. A. Ostroumov (*Ann. Chim. analyt.*, 1937, [iii], 19, (6), 145-152; (7), 173-176).—The Zn is first separated by precipitation as ZnS from a  $CH_2Cl \cdot CO_2H$  solution containing  $CH_3 \cdot CO_2Na$  (to  $p_H$  2.6-2.7) and acrolein. The precipitate is then dissolved in HCl and the Zn precipitated from the neutral solution with anthranilic acid (see Mayr, *Met. Abs. (J. Inst. Metals)*, 1933, 53, 453).—A. R. P.

**Application of Diphenylcarbazono to the Determination of Metals.** E. S. Vassermann and I. Suprunovich (*Ukrainski Khimichnii Zhurnal (J. Chim. Ukraine)*, 1934, 9, 330-340; *Brit. Chem. Abs.*, 1935, [A], 950).—[In Ukrainian.] Many cations are quantitatively precipitated as complexes insoluble in  $H_2O$ , but soluble in organic solvents; the application of such solutions to the colorimetric determination of the metals gives untrustworthy results. Pb, Hg, and Zn may be determined gravimetrically as complexes.—S. G.

**\*Quantitative Determination of Aluminium by Precipitation with Urea.** Hobart H. Willard and Ning Kang Tang (*Indust. and Eng. Chem. (Analyt. Edn.)*, 1937, 9, (8), 357-363).—The sulphate or chloride solution is treated with  $NH_4Cl$ , 10-20,  $(NH_4)_2SO_4$ , 1, and urea 4 grm., and boiled for 1-2 hrs. after the appearance of a turbidity; the  $p_H$  increases slowly during this time to 6.5-7.5, owing to hydrolysis of the urea, and the Al is precipitated as  $Al(OH)_3$  in a dense form, which has a much smaller tendency to occlude other hydroxides. Ca, Mg, and Mn are separated in one precipitation of the Al by this method, and Co, Ni, Zn, and Cu by two precipitations. If  $NH_4$  succinate is used instead of  $(NH_4)_2SO_4$ , the Al is precipitated quantitatively at  $p_H$  4.2-4.6. All the above metals, as well as Cd, can be separated in one precipitation, but if Zn is present the ignited  $Al_2O_3$  should be heated in  $H_2$  at 900° C. to volatilize any Zn carried down. If the solution contains Fe or Cu, phenylhydrazine should be added before boiling, to reduce these metals to their lower valency. The method gives good results in the analysis of Zn-base die-casting alloys.—A. R. P.

**Test Paper for Aluminium.** W. E. Thrun (*J. Chem. Education*, 1937, 14, (6), 281).—"Aluminon" test paper is used for the qualitative determination

and for the rough quantitative estimation of Al. The paper is prepared by soaking ashless filter-paper in a 0.1% solution of the ammonium salt of aurintricarboxylic acid containing about 1% of ammonium acetate. One drop of the (acidified) solution to be tested is allowed to fall on the test paper, and this is exposed to ammonia gas for about 10 seconds. The presence of Al in one part in 300,000 is shown by the appearance of a deep pink spot after about 1 hr.—J. H. W.

**\*Reduction of Silver Nitrate by Arsine and Its Use for Estimating Minute Amounts of Arsenic.** J. H. Krepelka and J. Fanta (*Coll. trav. chim. Tchecoslov.*, 1937, 9, (2/3), 47–67).—[In English.] Passage of  $H_2$  containing a little  $AsH_3$  through  $AgNO_3$  solution precipitates more Ag than corresponds to the  $AsH_3$ , owing to the reducing action of the  $H_2$ , and the precipitate contains a small amount of As, which escapes oxidation to  $As_2O_3$ ; these sources of error tend to compensate one another, but the method cannot be recommended for determining small amounts of As with accuracy by titrating either the Ag precipitated or the excess remaining in solution.—A. R. P.

**\*On the Determination of Small Amounts of Arsenic in Tin.** B. Tougarinoff (*Bull. Soc. chim. Belg.*, 1937, 46, (4), 141–170).—The metal (25 grm.) containing less than 0.5% Sb is boiled for 20 minutes with 220 c.c. of  $FeCl_3$  solution (1 kg. of As-free crystals dissolved in 250 c.c. of water), 100 c.c. of HCl ( $d$  1.19) are added, and the mixture is distilled until 100 c.c. of distillate are obtained; this is neutralized with NaOH, and the As titrated directly with 0.02N-I or with 0.05N-KBrO<sub>3</sub>. Alternatively, the metal may be dissolved in concentrated  $H_2SO_4$ , and the As distilled off after addition of HCl and a  $N_2H_4$  or  $NH_2OH$  salt; the distillate is saturated with  $H_2S$ , the  $As_2S_3$  collected, washed free from HCl, and dissolved in NaOH; the solution is oxidized with  $HNO_3$ , the As precipitated as  $Ag_3AsO_4$ , and the Ag in the precipitate determined by titration with  $NH_4CNS$ . In Sn with a low Sb content, the metal may be dissolved in HCl and the evolved  $AsH_3$  collected in  $H_2O_2$  and  $HNO_3$  for the  $Ag_3AsO_4-NH_4CNS$  titration.—A. R. P.

**\*Thiourea in Quantitative Analysis. I.—A New Determination of Cadmium and Separation from Zinc.** C. Mahr and Hertha Ohle (*Z. anal. Chem.*, 1937, 109, (1/2), 1–5).—The solution of the two metals is adjusted to 0.1N and treated with sufficient  $CS(NH_2)_2$  to give a 1% solution; the Cd is then precipitated by addition of a solution of  $(NH_4)_2[Cr(NH_3)_2(CNS)_4]$  containing 1% of  $CS(NH_2)_2$ . After keeping for 1 hr. in ice-cold water the red precipitate of  $Cd[CS(NH_2)_2]_2[Cr(NH_3)_2(CNS)_4]_2$  is collected on a glass filter, washed with ice-water, and dried at 110° C.; it contains 12.47% Cd.—A. R. P.

**Determination of Chromium by the Liquid Amalgam Method.** P. G. Popov and M. A. Nechamkina (*Ukrainski Khimichni Zhurnal (J. Chim. Ukraine)*, 1935, 10, 187–192; *Brit. Chem. Abs.*, 1935, [A], 1216).—[In Ukrainian.] The solution containing  $Cr^{III}$  or  $Cr_2O_7^{II}$ , is reduced by Zn–Hg in 6N- $H_2SO_4$ , and  $Cr^{II}$  is titrated with  $KMnO_4$ .—S. G.

**\*Determination of Chromium in Ferrochrome.** Phosphoric Acid as Solvent with Mixed Perchloric Acid and Sulphuric Acid as Oxidant. G. Frederick Smith and C. A. Getz (*Indust. and Eng. Chem. (Analyt. Edn.)*, 1937, 9, (8), 378–381).—Ferrochromium dissolves readily in hot syrupy  $H_3PO_4$ , even when the Cr and C contents are high; 5 c.c. of 85% acid are used for 100 mg. of alloy, and the temperature is increased slowly from 160°–170° C. to 250° C. during 10 minutes.  $H_2$  is evolved, and no Si or C separates, all the C being evolved as hydrocarbons. After dissolution is complete, 15 c.c. of a 1:1 mixture of 72%  $HClO_4$  and 80%  $H_2SO_4$  are added, and the mixture slowly heated to 210° C. for 5 minutes, cooled, diluted, boiled with a little  $(NH_4)_2S_2O_8$  to ensure complete oxidation of the Cr to  $CrO_4^{II}$ , then with a few drops of HCl to destroy  $KMnO_4$ , cooled and titrated with  $FeSO_4$  using o-phenanthroline as internal indicator.—A. R. P.

\***The Behaviour of Chromium to 8-Hydroxyquinoline.** Oskar Hackl (*Z. anal. Chem.*, 1937, 109, (3/4), 91-93).—Attention is directed to the fact that both chromic salts and chromates in neutral acetate solutions give precipitates with 8-hydroxyquinoline, but complete precipitation is obtained only on evaporating to a low volume. The precipitate can be ignited directly to oxide; its composition has not been determined.—A. R. P.

\***The Colorimetric Determination of Cobalt in Metallic Nickel.** J. J. Lurie and M. I. Troitzkaja (*Mikrochem.*, 1937, 22, (1), 101-108).—The metal is dissolved in  $\text{HNO}_3$ , the solution evaporated with  $\text{HCl}$  to remove  $\text{NO}_3^-$ , and any  $\text{Cu}$  precipitated with  $\text{NH}_4\text{CNS}$  and  $\text{Na}_2\text{SO}_3$ . The filtrate is treated with  $\text{Na}_4\text{P}_2\text{O}_7$ , neutralized to phenolphthalein by addition of  $\text{NaOH}$ , treated with  $\text{NH}_4\text{CNS}$  and a few drops of  $\text{NH}_4\text{OH}$ , and shaken with acetone. The upper layer, containing all the  $\text{Co}$  as blue  $(\text{NH}_4)_2\text{Co}(\text{CNS})_4$ , is transferred to a colorimeter, and the colour matched against standards in the usual way. The process may be shortened by precipitating the  $\text{Co}$  with  $\alpha$ -nitroso- $\beta$ -naphthol from the  $\text{HCl}$  solution of the metal, after first adding 0.05 gm. of  $\text{Fe}^{+++}$  as a collector; the washed precipitate is ignited, the oxide residue dissolved in  $\text{HCl}$ , the solution treated with  $\text{Na}_4\text{P}_2\text{O}_7$ , neutralized, &c., and the determination finished as above.—A. R. P.

\***The Determination of Cobalt. A New Volumetric Determination and a New Method for Its Determination in Steel.** B. S. Evans (*Analyst*, 1937, 62, (734), 363-377).—The  $\text{Co}$  solution (100 c.c.) is treated with 20 c.c. of saturated borax solution and 10 c.c. of 4%  $\text{KI}$  solution, and titrated with  $\text{KCN}$  until the pink precipitate dissolves and the liquid is only slightly turbid ( $V$  c.c.); a further  $0.3V + 5$  c.c. of  $\text{KCN}$  is then added, followed by 10 c.c. of 10%  $\text{Na}_2\text{CO}_3$  solution, and a rapid stream of air is drawn through the mixture for 6 minutes. Then 10 c.c. of 1 : 1  $\text{NH}_4\text{OH}$  and 25 c.c. of 20%  $\text{NH}_4\text{Cl}$  are added, to obtain a clear solution with all the  $\text{Co}$  as  $\text{Co}(\text{CN})_5^{--}$ ; the excess  $\text{KCN}$  is titrated with  $\text{AgNO}_3$  solution (5.792 gm./litre) until turbid, and then with  $\text{KCN}$  until clear. The  $\text{KCN}$  equivalent to the  $\text{AgNO}_3$  is deducted from the total used, and the remainder calculated to the equivalent in  $\text{AgNO}_3$ ; the c.c. of  $\text{AgNO}_3$  multiplied by 0.803 gives the mg. of  $\text{Co}$  present. If  $\text{Ni}$  is also present, the solution is boiled with  $\text{H}_2\text{O}_2$  to destroy the  $\text{Ni}(\text{CN})_4^{--}$ , and again titrated with  $\text{KCN}$  to obtain the  $\text{Ni}$ ;  $\text{Co}$  is found by difference. The method is useful for determining the composition of  $\text{Ni-Co}$  alloy plate.—A. R. P.

\***The Microdetermination of Gold.** W. B. Pollard (*Analyst*, 1937, 62, (737), 597-603).—The solution of  $\text{AuCl}_3$  obtained in the usual way is buffered with  $\text{KHF}_2$ , and titrated with hydroquinone, using *o*-dianisidine as indicator. If other metals are present, the  $\text{Au}$  is first separated in 10-42 volume-% of concentrated  $\text{HCl}$  by passing  $\text{SO}_2$ , a small amount of  $\text{TeO}_2$  being added first so that the precipitated  $\text{Te}$  acts as a collector for the  $\text{Au}$ ; the  $\text{Au-Te}$  precipitate is dissolved in  $\text{HCl}$  and  $\text{Br}$ , and the  $\text{Au}$  precipitated with metal or *p*-phenylenediamine to remove any  $\text{Pd}$ , redissolved in  $\text{Br-HCl}$ , and titrated as above, after removal of excess  $\text{Br}$  with a current of air.—A. R. P.

**Determination of Magnesium in Aluminium Alloys.** I. Ubaldini and U. Pelagatti (*Chimica e Industria* (Italy), 1937, 19, 131-133; *C. Abs.*, 1937, 31, 4921).— $\text{Mg}$  can be precipitated directly (without the previous removal of group III and IV metals) with  $\text{Na}_3\text{PO}_4$  (tartaric acid is used to prevent the precipitation of  $\text{Al}$ ). However, in alloys low in  $\text{Mg}$ , such as Duralumin, Anticorodal, KS alloy, &c., tartaric acid prevents the complete precipitation of  $\text{Mg}$ . The use of citric acid in place of tartaric acid assures complete precipitation of  $\text{Mg}$ , except when  $\text{Mn}^{++}$  is present. When  $\text{Mn}$  is present, it must first be removed by oxidation with  $(\text{NH}_4)_2\text{S}_2\text{O}_8$  in presence of  $\text{HNO}_3$ .—S. G.

**Determination of Nickel [in Alloys] as Nickel Dimethylglyoxime.** E. Azzarello, A. Accardo, and F. Abramo (*Atti V Congr. Naz. Chim.*, 1936, 14, 658-667; *Brit. Chem. Abs.*, 1937, [B], 353).—The determination of  $\text{Ni}$  in



alloys by the above method may give inexact results if Zn has been separated previously as ZnS in presence of  $\text{CH}_2\text{Cl}\cdot\text{CO}_2\text{H}$ . Exact results are obtained if the solution is treated with  $\text{SO}_2$ , and the precipitation of the Ni complex carried out in aqueous  $\text{NH}_3$  solution.—S. G.

**\*Determination of Nickel by Permanganometry.** J. Ledrut and L. Hauss (*Bull. Soc. chim. France*, 1937, [v], 4, (6), 1136-1141).— $\text{NiC}_2\text{O}_4$  is quantitatively precipitated in a readily filtrable form by adding a 2% solution of  $\text{Na}_2\text{C}_2\text{O}_4$  to the hot solution containing 25% of  $\text{H}\cdot\text{COOH}$ ; after overnight digestion on the water-bath, the precipitate is collected, washed with 25%  $\text{H}\cdot\text{COOH}$ , and dissolved in hot 10%  $\text{H}_2\text{SO}_4$ , the liberated  $\text{H}_2\text{C}_2\text{O}_4$  being titrated with  $\text{KMnO}_4$  at  $70^\circ\text{C}$ . after diluting the solution to 600 c.c.—A. R. P.

**Arc Spectra of the Elements of the Platinum Group.** Josefina G. Aguado and S. Piña de Rubies (*Anales soc. españ. fis. quim.*, 1936, 34, (336), 875-900; *C. Abs.*, 1937, 31, 5675).—Arc spectra produced by  $5 \times 10^{-1}$  to  $5 \times 10^{-8}$  gm. of Pt, Ir, Pd, Rh, Ru, Au, and Os are shown, for the purpose of obtaining approximately quantitative results. Some equivalencies between lines of these elements, compared to those produced by  $10^{-1}$  gm. of Mo, are shown.—S. G.

**\*A Specific Method for the Determination and Separation of Thallium with "Thionalide."** Richard Berg and E. S. Fahrenkamp (*Z. anal. Chem.*, 1937, 109, (9/10), 305-315).—The Tl solution (100 c.c.) is treated with 10-25 c.c. of 20% Na tartrate solution, 2N-NaOH until pink to phenolphthalein, and sufficient 20% KCN solution to give a mixture containing 5% KCN and 2N-NaOH to make the liquid N with respect to NaOH (allowing for KCN alkalinity). The Tl is then precipitated as  $\text{C}_{10}\text{H}_7\text{NH}\cdot\text{CO}\cdot\text{CH}_2\text{STl}$  by adding a solution of 0.4-0.5 gm. of "thionalide" dissolved in 8-10 c.c. of acetone for every 0.1 gm. of Tl present. After heating to boiling, the precipitate is collected, washed with cold  $\text{H}_2\text{O}$ , then with acetone, and dried at  $100^\circ\text{C}$ .; it contains 48.60% Tl. If Hg, Bi, or Pb is present, 10 times the theoretical quantity of precipitant is added, followed by acetone to 30 volume-%; the Hg, Bi, and Pb compounds then remain in solution.—A. R. P.

**\*Bromopotentiometric Titration of Thallium with "Chloramine."** C. del Fresno and H. Aguado (*Z. anal. Chem.*, 1937, 109, (9/10), 334-338).—The method is based on the ability of Na *p*-toluenesulphochloroamine to oxidize  $\text{TlCl}$  to  $\text{TlCl}_3$  in HCl solutions containing KBr; the end-point is determined potentiometrically.—A. R. P.

**Analytical Notes on Tin Containers for Canning.** S. Lancefield (*Food*, 1936, 5, 469-471; *C. Abs.*, 1937, 31, 5459).—The thickness of Sn on a container is determined by dissolving off the Sn from a measured sample of plate and titrating the  $\text{SnCl}_2$  so obtained with  $\text{I}_2$ . The thickness of the coating is calculated from the weight of Sn found. A gelatin ferricyanide mixture placed on tinplate will show blue spots wherever the ferricyanide comes in contact with exposed Fe. For analysis of solder, the alloy is brought into solution with  $\text{HNO}_3$ , and  $\text{SnO}_2$  and  $\text{PbSO}_4$  determined gravimetrically. To determine Bi, precipitate as basic Bi formate, dissolve in dilute  $\text{H}_2\text{SO}_4$ , and titrate with  $\text{KMnO}_4$ . To determine whether cans are clean from traces of Zn, a qualitative test is made with resorcinol in dilute  $\text{NH}_3$  on the wash water from the cans.

—S. G.

**\*The Peroxide Method for Vanadium. A Spectrophotometric Study.** E. R. Wright with M. G. Mellon (*Indust. and Eng. Chem. (Analyt. Edn.)*, 1937, 9, (8), 375-376).—The effects of acid concentration, volume of  $\text{H}_2\text{O}_2$  used, and numerous other ions on the colour developed by  $\text{H}_2\text{O}_2$  in acid vanadate solutions were studied. The best results were obtained in 0.6-6N- $\text{H}_2\text{SO}_4$ , HCl, or  $\text{HNO}_3$ , and 0.5-3 c.c. of 3%  $\text{H}_2\text{O}_2$  per 100 c.c. of solution.—A. R. P.

**Microanalytic Determination of Zinc and Its Application to the Analysis of Brass.** P. Wenger, Ch. Cimerman, and G. Tschanun (*Mikrochim. Acta*, 1937, 1, 51-54; *C. Abs.*, 1937, 31, 5714).—Place 2-3 ml. of the slightly acid solution

containing 0.5–3 mg. of Zn in a test-tube 15 mm. in diameter and 110 mm. long. Add, drop by drop, avoiding an excess, 10% NaOH until the  $Zn(OH)_2$  formed redissolves. Then, in the micro-electrolytic apparatus of Pregl, electrolyze with a current of 0.2–0.8 amp. at 5–6 v. After 10 minutes, wash down the sides of the condenser. During the electrolysis the solution becomes heated. After 15 minutes, cool by placing the electrolytic tube in water and continue for 5 minutes more. The cathode should be coated with Cu, because Zn stains Pt. To analyze a sample of brass, first electrolyze the solution in the presence of acid to obtain a Cu deposit on Pt. Then, after removing this electrode, replace it with a Cu-plated electrode, make the solution alkaline, and deposit the Zn.—S. G.

**Potentiometric Determination of Zinc in Electrolytic Baths.** F. K. Fischer (*Zhurnal Prikladnoi Khimii (J. Applied Chem.)*, 1936, 9, (12), 2275–2282; *Brit. Chem. Abs.*, 1937, [B], 579).—[In Russian.] Zn is determined by electro-titration with  $K_3Fe(CN)_6$ ,  $NH_4^+$ ,  $Na^+$ ,  $NaOAc$ ,  $NaCl$ ,  $H_3BO_3$ , dextrin, and gum arabic interfere. Al and Fe should be converted into  $AlF_6^{3-}$  and  $FeF_6^{3-}$  before titration.—S. G.

**\*Arsenate Method for the Determination of Zirconium.** Walter C. Schumb and Edward J. Nolan (*Indust. and Eng. Chem. (Analyt. Edn.)*, 1937, 9, (8), 371–373).—The chloride solution is adjusted to 2.75*N*-HCl or 3.75*N*- $HNO_3$ , and 1%  $(NH_4)_2HAsO_4$  solution added until no further precipitate forms; 15 c.c. of a 10% solution of arsenate is then added and the solution boiled for 20 minutes. The  $Zr_3(AsO_4)_4$  precipitate is collected on a double filter-paper, washed with an acid 1% solution of the precipitant, and heated gently until the paper is charred, then more strongly until all the As is reduced and volatilized, leaving a residue of  $ZrO_2$ . The double paper and careful ignition are essential to ensure complete expulsion of the As. [Note by abstractor: Addition of filter pulp prior to filtration produces a rapid reduction of the As on ignition and assists filtration.] Ti, Nb, and Ta interfere;  $H_2O_2$  prevents precipitation of  $TiO_2$  and Nb, Ta, and W can be removed by fusing the ignited oxide with  $K_2CO_3$ .—A. R. P.

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

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

(Continued from pp. 401–416.)

**An Ultra-Microscope for Metals.** F. Burmistrov (*Tech. Physics U.S.S.R.*, 1937, 4, (4), 325–329).—[In English.] A portable ultra-microscope with possible magnification up to 1200, designed for the study and photography of polished metal surfaces, is described. It can be placed directly on the surface to be examined so that different parts of the surface can be examined without alteration of focus. It is peculiarly suited for determining whether even the slightest scratches remain on polished surfaces.—J. S. G. T.

**\*The Mechanical Development of the Microscope. A New Fine Adjustment.** Reginald S. Clay (*J. Roy. Microscop. Soc.*, 1937, [iii], 57, (1), 1–7).—Perfect response to movements of the focussing screw is not attainable if there is friction between sliding parts. It is proposed to eliminate all sliding friction by carrying the microscope body on flat annular springs, arranged to give straight-line movement with no side displacement of the axis.—J. C. C.

**\*An Illuminator for Opaque Objects.** G. Dallas Hanna (*J. Roy. Microscop. Soc.*, 1937, [iii], 57, (1), 11–14).—An illuminator, projecting a brilliant spot of light free from all colour aberration, and having the diffusion of the filament image under complete control, is described. A concave mirror is used to collect and reflect the light from a 6–8 v. bayonet-type 15 c.p. car lamp.—J. C. C.

**Microphotographic Apparatus for the Examination of Opaque Objects.** Carl Zeiss (London), Ltd. (*J. Sci. Instruments*, 1937, 14, (3), 109–110).—An

inverted microscope, in which the object examined is placed on a table above the rest of the apparatus, is described. The device may be used with either bright or dark field illumination, and also with polarized light, and is suitable for either visual or photographic, micro- or macroscopic work. It can be readily converted into a standard instrument for investigations with transmitted light.—J. S. G. T.

**A New Method for the Examination of [Exposed Photographic] Films and Plates.** P. M. Wolf and N. Riehl (*Z. tech. Physik*, 1937, 18, (4), 89-90).—Ultra-violet light falls on the plates laid on a fluorescent background. Contrast, as seen in the visible light reflected from the background and traversing the film, is thereby increased.—J. S. G. T.

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

(Continued from pp. 406-408.)

**\*Contribution to Our Knowledge of the Mechanism of Wear in Short Time Tests with Examples of Pure Metals.** Willi Tonn (*Z. Metallkunde*, 1937, 29, (6), 196-198).—The rate of wear of pure metals against a rotating steel disc or glass disc, against a revolving ring covered with emery paper, and against an emery-covered drill was measured, and the results are shown graphically. The order of wear-resistance of the metals varies considerably with the method of testing, and with the conditions under which the test is made. If, however, in the emery test the paper is first standardized by measuring its abrasive action on celluloid, and the results obtained for the metals are correlated to a wear of 2 mm. of celluloid, the wear-resistance can be shown to be a linear function of the hardness of the metal. Homogeneous alloys behave like pure metals, but heterogeneous alloys show considerable deviations from this rule.—A. R. P.

**Nomenclature for Various Ranges in Stress in Fatigue.** — (*Amer. Soc. Test. Mat. Preprint*, 1937, (June), 3-5).—Appendix to Report of the Research Committee on Fatigue of Metals. Two types of nomenclature commonly employed in English-speaking countries for specifying ranges of stress in fatigue tests are briefly illustrated. In the one system the ratio ( $r$ ) between minimum and maximum stress is specified; in the second system the stress cycle is analyzed into a mean steady stress and a superposed alternating stress. A third system, in which maximum stress is plotted as ordinates, minimum stress as abscissæ, and curves are drawn for endurance limits in various cycles, is briefly discussed. The direct axial tension-compression test is almost the only test which gives reliable stress measurements when the metal is stressed into the plastic range.—J. S. G. T.

**Fatigue Resistance and Allowable Stress of Ductile Materials Under Combined Alternating Stresses.** Kazuo Terazawa (*J. Zosen Kiokai (Soc. Naval Arch. Japan)*, 1936, 59, 15-44).—[In English.] Taking separately into account effects due to mean stress and to variable stress in the fatigue failure of ductile materials, T. finds, by comparison of test data for bending with those for twisting, that the shear strain energy law (v. Mises-Hencky law) holds more accurately than the maximum shear stress law (Guest-Mohr law) for combined alternating stresses. If the range of variable shear strain energy does not exceed a certain constant value, and if the maximum shear strain energy during a cycle does not exceed the shear strain energy corresponding to the statical yield-point, then a ductile material can sustain an infinite number of cycles of combined stresses with neither fatigue failure nor statical yielding. A method for determining the allowable stress for ductile materials under combined alternating stresses, incorporating these results, is discussed.—J. T.

\*A New Method for the Determination of the Modulus of Elasticity and Damping. Fritz Förster (*Z. Metallkunde*, 1937, 29, (4), 109-115).—See also Förster and Köster, *Met. Abs.*, this vol., p. 427. The method depends on the determination of the resonance curve by means of an electromagnet, amplifier, and galvanometer operated by the vibrations set up in a suspended specimen of metal struck a blow to set it "ringing." For a cylindrical specimen of length  $l$ , weight  $g$ , and density  $d$  the elastic modulus  $E$  in kg./mm.<sup>2</sup> is given by the expression:  $E = 1.6388 \times 10^{-8}(l/d)^1(g/l)v_E^2$ , and for a prismatic specimen by the expression:  $E = 0.96535 \times 10^{-8}(l/a)^3(g/b)v_E^2$ , where  $a$  is the width parallel to, and  $b$  the breadth transverse to, the plane of vibration. The width of the curve at half the maximum amplitude ( $\Delta v_H$  vibrations per second) is a measure of the mechanical damping ( $\theta$ ), which can be calculated from the expression  $\theta = 1.8136\Delta v_H/v_E$ . Irregular resonance curves are obtained when the specimen is not exactly circular, or when the elastic modulus has different values in different directions, e.g. when the metal is hard-rolled; from the frequency of these so-called "Lissajou" effects, conclusions can be reached as to the magnitude of the difference between the elastic moduli or the deviation from true roundness. Apparatus for making the tests at room and at elevated temperatures, and for different shapes of test-pieces, is described.—A. R. P.

\*The Determination of the Necessary Magnification for Measuring Vickers [Hardness] Impressions. Karl Sporkert (*Z. Metallkunde*, 1937, 29, (5), 168-170).—The accuracy of the measurement of Vickers pyramid impressions is proportional to the magnification only up to a magnification of 50 diameters; higher magnifications only increase the accuracy of the readings relatively slightly and are, therefore, unnecessary under practical conditions.—A. R. P.

#### RADIOLOGY

All-Union Conference on the Use of X-Ray Analysis in Industry. W. Arkharov (*Tech. Physics U.S.S.R.*, 1937, 4, (4), 330-335).—[In English.] Papers read at the All-Union Conference on X-Ray Analysis in Industry, Oct., 1936, are referred to briefly. The large gap between the real possibilities and the actual applications of X-rays in industry was dealt with. X-rays have been applied to elucidate the cause of rejects in the welding of tantalum rods, the control of hard alloys, and to investigate the causes of rejects of tramway lamps and copper-graphite brushes, and the control of normalizing processes. A number of speakers objected to mass control processes. Certain desirable developments, e.g. the detection of gases in metals, were referred to. The need for an X-ray atlas was stressed. The necessity for combining radiology with magnetic methods of detecting flaws was mentioned. Other subjects discussed included "The application of X-ray analysis in the thermal treatment of alloys"; "X-ray analysis in the control of pressure treatment," e.g. in the control of intermediate tempering in the region of the "Erhöhung" of aluminium alloys.—J. S. G. T.

X-Ray Protection. (*U.S. Nat. Bur. Stand. Handbook*, 1936, (20), 28 pp.).—Supersedes *Handbook* 15, and contains safety recommendations relating to protection from X-rays and equipment, the storage of X-ray films and operating rules for X-ray workers, and instructions for resuscitation by artificial respiration. The recommendations have been drawn up on the suggestion of the International Safety Committee.—J. S. G. T.

## XII.—TEMPERATURE MEASUREMENT AND CONTROL

(Continued from p. 408.)

\*Reliability of Common Types of Thermocouples. D. Quiggle, C. O. Tongberg, and M. R. Fenske (*Indust. and Eng. Chem.*, 1937, 29, (7), 827-830).—Work on the effects of heat-treatment of base-metal thermocouples is described.

For the conditions under which the tests were made, it appears that: (1) Heat-treatment of copper-Copel (copper 55, nickel 45%), copper-Constantan and Chromel-Alumel thermocouples above about 200° C. causes them to indicate temperatures different from those before heat-treatment. Greater discrepancies are shown the higher the temperature of heat-treatment and the higher the temperatures indicated. (2) Copper-Copel and copper-Constantan couples heated between 200° and 350° C. indicate higher temperatures than before such treatment; heat-treatment above 300°-350° C. causes them to indicate lower temperatures. It is concluded that these 2 forms of couple possess a rather high degree of reliability if used in the temperature range 0° to 200° C.—F. J.

**Pyrometry.** Harley Carter (*Elect. Ind.*, 1937, 37, (1880), 519-522).—An elementary review. Reference is made to a recent galvanometer for measuring up to 5 mv., in which the movement is magnetically suspended in the field of the magnet, and to a double-wound galvanometer having considerable sensitivity over a restricted range (corresponding to any predetermined temperature) for use with resistance pyrometers.—J. C. C.

### XIII.—FOUNDRY PRACTICE AND APPLIANCES

(Continued from pp. 408-410.)

**The Metallurgical Evolution of the Foundry.** A. Portevin (*Bull. Assoc. Tech. Fonderie*, 1937, 11, (2), 58-65).—A comprehensive survey is given of the fundamentals underlying foundry practice, the vital factors being classified as: (1) choice of alloy composition and method of melting; (2) conditions of melting and mixing; (3) conditions of casting and solidification; (4) thermal treatment; and (5) control of the operations and products.—H. W. G. H.

**Feeding Aluminium-Alloy Castings.** R. Perret (*Congrès internat. Fonderie, Paris* (Preprint), 1937, 6 pp. (in French); also *Found. Trade J.*, 1937, 57, (1095), 126-128; and *Mét. Ind. (Lond.)*, 1937, 51, (9), 211-213).—The fundamental principles governing the elimination of blowholes and included oxide films are explained. Blowholes are frequently caused by faulty pouring methods; the cross-section of the down-gate should not be too great and should be oval in order that the down-gate may be kept full during pouring. In addition, variable slope should be given to the runner to prevent the gyratory motion of the metal in the hole. Films of oxide are usually found in the vicinity of the ingates; to eliminate them, the velocity of metal entering the mould must be kept below the limiting value above which the oxide film surrounding the metal is ruptured. The height of fall of the metal should, therefore, be limited, and ingates should be larger in cross-section than the down-gate.—H. W. G. H.

**Notes on the Light Foundry Alloy A.P. 33.** J. Castel (*Congrès internat. Fonderie, Paris* (Preprint), 1937, 6 pp. (in French); and *Found. Trade J.*, 1937, 57, (1099), 194-196).—This aluminium alloy contains about 4.5% copper and 0.25% titanium, and, after solution heat-treatment at 530° C., followed by ageing at 140° C., has a tensile strength of 20-20½ tons/in.<sup>2</sup> with elongations of 6-10%. The iron and silicon contents must be kept below 0.45 and 1.25%, respectively, and a flux with a titanium fluoride base is used at each remelting. The addition of 0.20% magnesium raises the elastic limit and makes ageing take place at room temperature.—H. W. G. H.

**Non-Metallic Inclusions in Brass Chill-Castings.** L. Lencauchez (*Mét. const. mécan.*, 1935, 67, (10), 14-15; *Chem.-Zentr.*, 1935, 106, (II), 1085).—Sources of non-metallic inclusions are discussed.—S. G.

**The Application of the Pneumatic Micrometer to the Control of Castings.** Louis Wattebot and Achille Brizon (*Congrès internat. Fonderie, Paris* (Preprint), 1937, 6 pp. (in French); and *Found. Trade J.*, 1937, 57, (1097), 155-156).—The instrument, which is described, measures with extreme

accuracy the size of circular orifices. It is suitable, therefore, for examining such castings as die-cast carburettor bodies, in which dimensional accuracy is important. The design of the instrument permits its use for routine testing of such castings, and also for testing soundness of sand-castings.—H. W. G. H.

**Split Patterns and Pattern Plates.** James Timbrell (*Found. Trade J.*, 1937, 57, (1099), 193).—An apparatus is described for the accurate marking out of single reversible or double-sided pattern plates.—H. W. G. H.

**\*A Study of Non-Ferrous Moulding Sands.** H. W. Dietert and Earl Woodliff (*Trans. Amer. Found. Assoc.*, 1937, 45, 82-96).—Twenty samples of sand, for moulding aluminium, brass, bronze, copper-nickel, and copper, were obtained from 13 foundries, together with particulars of moulding methods and casting weights. The samples were subjected to the usual tests for green strength, permeability, &c., and the results are tabulated. It was found that the permeability was below 10 for aluminium, and between 10 and 20 for brass and bronze sands; the average green compression strength was 7.5 lb./in.<sup>2</sup>., and most of the samples contained a considerable proportion of fines passing through a 270 sieve. Formulæ are derived for calculating permeability and the approximate moisture content required.—H. W. G. H.

**\*Relationships Between the Foundry Properties of Moulding Sands.** Fr. Pisek and B. Holman (*Congrès internat. Fonderie, Paris* (Preprint), 1937, 11 pp. (in French); and (summary) (*Found. Trade J.*, 1937, 57, (1098), 178).—From tests on 48 types of moulding sand, relationships have been determined between: (1) cohesion and grain-size and clay content; (2) gas permeability and grain-size and clay content; and (3) gas permeability and grain-size and cohesion. The algebraical expressions and appropriate nomograms are given.—H. W. G. H.

**Non-Ferrous Foundry Sand Control. Fundamental Principles of New System.** G. K. Eggleston (*Trans. Amer. Found. Assoc.*, 1937, 45, 110-121; discussion, 124-129; also *Met. Ind. (Lond.)*, 1937, 51, (2), 40-44; and *Found. Trade J.*, 1937, 57, (1096), 137-138, 142).—The effect of grain-size and grain distribution on permeability and casting finish is explained, and it is shown that bond strength depends on the type of clay, rather than the total clay content. The benefits of sand control are pointed out, and recommendations are made for beginning a system of control.—H. W. G. H.

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

(Continued from p. 356.)

**Evaluation of Light Metal Residues.** H. Reininger (*Metallwaren-Ind. u. Galvano-Tech.*, 1937, 35, (1), 32-33; (2), 51-52).—Methods are briefly described for collecting, drying, degreasing, and storing aluminium alloy and Elektron scrap, so as to avoid mixing unsuitable material and to obtain maximum recovery. The magnetic separation of ferrous metal particles, and the crushing and sieving of melting dross, are also discussed.—A. R. P.

#### XV.—FURNACES AND FUELS

(Continued from pp. 410-411.)

**Non-ferrous Melting Requires Excellent Furnace Operation.** N. K. B. Patch (*Foundry*, 1937, 67, (7), 25-26, 66, 68).—Discusses maintenance of lining, types of refractory material, fuel and air-supply, and control of crucible, barrel, and rocking-arc furnaces.—H. W. G. H.

**High-Frequency Electric Induction Furnace.** J. M. Torroja and G. de Montaud (*Anales soc. españ. fis. quim.*, 1934, 32, 787-799; *Brit. Chem. Abs.*, 1936, [B], 1163).—An oscillating circuit (approx.  $1056 \times 10^3$  cycles/second),

including a 3-electrode valve with an anode voltage of 2400 v., gives a current of 63 amp. in a graphite crucible, which can be brought by this means to 2000° C. in 5 minutes.—S. G.

[Russ] **Electric Rocking Furnace.** A. J. G. Smith (*Elect. Rev.*, 1937, 121, (3111), 45).—A 1-ton Russ arc-type rocking furnace is briefly described. Detailed figures are tabulated for power, water, and electrode consumption with total German melting costs for various materials, including copper and nickel alloys.—J. C. C.

**Furnace Heating by Electricity.** H. Knight (*Elect. Ind.*, 1937, 37, (1898), 1108–1109).—An address to the Falkirk and District Electrical Society.—J. C.

**Precautions for Construction, Working and Repair of Coal Drying and Pulverizing Plants.** — (*Brit. Home Office (Factory Dept.) Form No. 831*, 1937, 2 pp.).—S. G.

## XVI.—REFRACTORIES AND FURNACE MATERIALS

(Continued from pp. 411–412.)

**Relation Between Density, Fluidity of, and Attack on Fireclay by Glasses [and] Slags at High Temperatures.** K. Endell and C. Wens (*Indust. Heating*, 1937, 4, (2), 143–144, 146).—From *Glastech. Ber.*—The relation between density and viscosity is of importance in the attack of slags in metallurgical processes and on furnace linings. The attack of liquid glasses and slags on fireclay and silica bricks increases with the degree of fluidity, almost independently of the chemical composition of the attacking material. The density of glasses and slags decreases with increase in temperature, being about 10% less at 1400° C. than at 20° C. The density influences the velocity with which the particles dissolved by the attacking material are carried away by the flow of the liquid mass, the kinetic energy increasing with increasing density. Both fluidity and density of the attacking masses accelerate, at high temperatures, the equalization of concentration between refractory and slag, *i.e.* the degree of destruction of the refractory. Accelerated attack begins only after the fluidity has reached a degree which corresponds to a dynamic viscosity of 35 c.g.s. units, or, at an average density of 3, to a kinetic viscosity of about 10.—W. A. C. N.

**Application of Mullite Refractory Materials to Furnaces.** Marcel Lépingle (*Chim. et Ind.*, 1936, 36, (6), 1087–1094).—The conditions under which sillimanite products are used in furnace work are examined, though it is remarked that under normal high temperature conditions the term “mullite” is more appropriate to the silica-alumina combinations which then exist. Practical examples are cited, as well as the results of laboratory study, and attention is also directed to the disadvantages which these highly aluminous materials possess. It is pointed out that the criterion of successful burning of the raw material is a sp. gr. (2.97) of the final product lower than that of any ingredient, sillimanite, disthene, or andalusite. Any higher figure indicates that the temperature transformations suitable for refractory purposes have not taken place.—W. A. C. N.

## XVIII.—WORKING

(Continued from pp. 412–413.)

**Coefficient of Friction and Flow in Strip Rolling.** W. Trinks (*Blast-Fur. and Steel Plant*, 1937, 25, (7), 713–715).—Discusses the coeff. of friction in hot-rolling and cold-rolling; natural flow-resistance, and the effect of variable flow-resistance. The article is illustrated with charts.—R. Gr.

**Rolling One-Piece Finned Tubing.** — (*Machinery (Lond.)*, 1937, 50, (1297), 645–646).—A brief, illustrated account of a method of rolling a helical fin

on seamless copper or aluminium tubing. Three rotary forming tools first press a helical groove and then exert a lateral squeezing pressure on the material between the grooves.—J. C. C.

**Roll Grinding. Relation of Lubrication to Precision Finishing.** — (*Lubrication*, 1937, 23, (5), 49-56).—S. G.

**The Properties of Sheet Metal. II.—The Testing of Deep-Drawing Quality Sheet.** J. D. Jevons (*Met. Ind. (Lond.)*, 1937, 51, (9), 207-210; (10), 227-231).—Chemical analysis, microscopical and X-ray examination, tensile, hardness, bend, tear, and cupping tests are discussed, the merits of each, from a practical point of view, being compared with its capability of measuring properties which are fundamental to the deep-drawing process. The importance of expert microscopical examination of properly-prepared specimens, as distinct from cursory estimation of "average grain-size," is stressed, and, in the case of hardness and cupping testing, the various methods available are briefly described. 23 references are given.—H. W. G. H.

**Production of Double-Pointed Vertically-Cast Wire-Bar.** Frederick Benard (*Met. Ind. (Lond.)*, 1937, 51, (9), 201-202).—Describes a machine used by the Ontario Refining Co. for machining a nose on both ends of vertically-cast copper wire-bars.—H. W. G. H.

**Free-Cutting Light Metal Alloys with an Aluminium-Magnesium Base.** Hans Bohner (*Aluminium*, 1937, 19, (3), 131-139; discussion, 177-181).—Although addition of lead to aluminium alloys for working on the lathe produces satisfactory short turnings, the presence of lead in the alloy necessitates a special casting technique, reduces the resistance to corrosion and the strength and elongation of the alloy, and renders the scrap useless for making up other alloys. From a constructional point of view, much more valuable alloys are obtained by the addition of chromium or manganese aluminides to 8-10% magnesium-aluminium alloys, with or without 1-2.5% of silicon and up to 1% of iron to assist in breaking up and dispersing the aluminides. Dispersion of the hard constituents may be increased by a heterogenizing anneal. For high resistance to corrosion combined with high strength and good dispersion of the aluminides, the iron and silicon may be replaced by 0.5-1% of zinc and the metal used in the homogeneous condition.—A. R. P.

**Free-Cutting Alloys with Al-Cu-Mg or Al-Mg-Si Base.** H. Kästner (*Aluminium*, 1937, 19, (3), 140-150).—Addition of 1-3% of bismuth, cadmium, or lead to aluminium alloys of the Duralumin type renders them free-cutting on automatic screw-cutting machines. The yield-point, tensile strength, and hardness are reduced somewhat by the additions, but the elongation and electrical resistance remain practically unchanged. The endurance limit in corrosion-fatigue tests in sea-water is reduced by about 1 kg./mm.<sup>2</sup>.—A. R. P.

**\*New Researches on the Cutting Capacity of Light Metals Especially of Free-Cutting Alloys.** H. Opitz (*Aluminium*, 1937, 19, (3), 150-157).—The results are recorded in graphical form of tests made to determine the wear on the cutting tool, and the effect of the cutting angle and rate of lateral movement of the tool, in the lathe-cutting of various aluminium alloys containing special additions. For smooth, continuous running the shape of the turning is of great importance; it depends on the cutting conditions, *viz.* depth of cut, speed of the tool, and cutting angle. Short, brittle turnings are obtained with a very small cutting angle, which also favours the production of a smooth surface.—A. R. P.

**Milling Tools for Light Metals.** H. Klein (*Aluminium*, 1937, 19, (3), 164-166).—Modern types of tools are illustrated, and their performances discussed.—A. R. P.

**Tools for Drilling, Reaming, and Screw-Cutting Light Metals.** F. Pütz (*Aluminium*, 1937, 19, (3), 167-175).—Various types of drills, reamers, and



screw-cutters for use with Elektron and aluminium-base alloys are described, and the quality of their work is discussed.—A. R. P.

**Suitable Oils for Working Free-Cutting Light Metal Alloys.** K. Beuerlein (*Aluminium*, 1937, 19, (3), 175-176; discussion, 177-181).—The most suitable oils and lubricants for automatic machines working on free-cutting aluminium alloys are those used for cutting steels in similar machines. Owing to the low sp. gr. of the aluminium alloy turnings, the oil in the sump should be continuously purified by passing it through a centrifuge to remove coarse turnings, then through a heated (60°-70° C.) settling tank, a second centrifuge to remove finer particles of metal, and finally a filter.—A. R. P.

**Free-Cutting Aluminium Alloys in the Patent Literature.** E. Herrmann (*Aluminium*, 1937, 19, (3), 181-186).—A review of English, French, American, and Swiss patent specifications dealing with free-cutting aluminium alloys.

—A. R. P.

**\*Free-Cutting Aluminium Alloys.** R. Sterner-Rainer (*Aluminium*, 1937, 19, (4), 253-254).—Tests made on Duralumin (silicon 0.6, iron 0.5, copper 3.5, zinc 0.3, magnesium 0.6, manganese 0.5%) with and without additions of (a) 1-8% silicon, (b) 0.2% titanium, (c) 2.7% zinc, or (d) 0.5% each of lead and bismuth showed that, after ageing at 200° C., the only alloys which gave short chips on the automatic machine were those with 4.5-6.5% silicon. A similar test made on "German alloy" (copper 3.5, zinc 10%) prepared from scrap showed that 2.5% silicon or 3% silicon and 1.5% iron conferred free-cutting properties only after age-hardening and not in the cast state. Addition of 0.05% lithium to this alloy improves the tensile strength and ductility, and a further addition of about 1% each of lead, bismuth, and magnesium produces a very free-cutting alloy with good mechanical properties.—A. R. P.

**Free-Cutting Aluminium Alloys.** Hans Diergarten (*Metal Progress*, 1937, 32, (2), 165, 180).—A short review, with *bibliography*, of the development of the free-cutting aluminium alloys. A discussion held by the Materials Committee of the Aluminium-Zentrale (Berlin) is summarized (see preceding abstracts).—P. R.

**Machining Die-Cast Pistons.** — (*Machinery (Lond.)*, 1937, 50, (1298), 661-666).—Machining operations at a Twickenham works producing split-skirt type die-cast pistons (alloy not specified) are described in detail.—J. C. C.

**Revolving Draw-Bench and Automatic Machines for Working Light Metals.** Erich Hansgen (*Aluminium*, 1937, 19, (4), 249-252).—Modern types of machines are illustrated, and their uses described.—A. R. P.

**Take Care of Your Files!** — Borrmann (*Werkstatt u. Betrieb*, 1937, 70, (17/18), 232-234).—Considerable economy can be effected by the proper care of files. Types of file for brass, for copper, and for general use are illustrated, and methods of cleaning and sharpening are briefly described.—P. R.

## XIX.—CLEANING AND FINISHING

(Continued from p. 414.)

**Degreasing Preliminary to Electroplating.** V. P. Sacchi (*Industria meccanica*, 1937, 19, 322-324; *C. Abs.*, 1937, 31, 5688).—General observations of the necessity for, effects of, and methods of degreasing for good adhesion of electrodeposits.—S. G.

**Factors to Consider in Designing Dust Removal Systems.** C. C. Hermann (*Abrasives*, 1937, 18, (9), 14-16, 60-61).—S. G.

**Aluminium Finishing Procedure.—II.** Robert T. Griebing (*Products Finishing*, 1937, 1, (9), 14-18; *C. Abs.*, 1937, 31, 5731).—*Cf. Met. Abs.*, this vol., p. 414. A discussion of the use of aluminium for the manufacture of

perfect printing plates, the electrolytic coating of aluminium, the Alumilite process for treating aluminium, the use of dyed aluminium, and the use of oxide coatings for specular and diffuse finishes.—S. G.

**Rôle of Chemistry in Polishing Processes.** I. V. Grebenchtschikov (*Sozialisticheskaya Rekonstruktsiya i Nauk (Socialist Reconstruction and Science)*, 1935, (2), 22-23; *C. Abs.*, 1935, 29, 8173).—[In Russian.] In polishing metals, a protective layer is formed. Polishing steel in hydrogen or when connected to a cathode is slower than in hydrogen + hydrogen sulphide or air, or when connected to an anode. Polishing powders ( $\text{Cr}_2\text{O}_3$ ,  $\text{K}_2\text{Cr}_2\text{O}_7$ , and sulphur are best) absorb the fatty part of the stearic acid mol. used as a lubricant and are deposited on it in a unimolecular layer. Acid parts of the stearic acid mol. combine with surface oxides. The connection between metal and polishing material is broken during movement of the metal, and then re-established.

—S. G.

**Polishing and Buffing in Electroplating.** Oskar Krämer (*Metallwaren-Ind. u. Galvano-Tech.*, 1937, 35, (14), 292-294; (15), 314-316; (16), 336-339; (17), 357-359).—Discusses the properties and uses of the various polishing powders used on buffing wheels, in the preparation of metal surfaces for plating, and in the finishing of plated articles.—A. R. P.

**Physical Properties of Abrasive Grain for Polishing Uses.** A. H. Anderson (*Products Finishing*, 1937, 1, (10), 20-22; *C. Abs.*, 1937, 31, 5897).—Grid sizing and capillary of abrasive grain used for polishing should be checked carefully in the laboratory. The (U.S.) Abrasive Grain Association has established limits, covering these properties, as well as specifying suitable equipment for making the laboratory tests.—S. G.

**The Use of Etching Methods for Engraving [Copper, Brass, and Bronze] Objects.** Eugen Werner (*Metallwaren-Ind. u. Galvano-Tech.*, 1937, 35, (9), 194-195).—The process of engraving designs on copper and its alloys by etching with mixtures of nitric acid and potassium chlorate or other oxidizing agent is described in detail, and the compositions of some solutions for subsequent colouring of the etched surface are given.—A. R. P.

**Pigmented Lacquers.** G. Howse (*J. Electrodepositors' Tech. Soc.*, 1937, 12, 129-132).—S. G.

**Transparent Lacquers.** A. F. Brockington (*J. Electrodepositors' Tech. Soc.*, 1937, 12, 133-138).—S. G.

## XX.—JOINING

(Continued from pp. 414-417.)

**The "Arcatom" [Atomic Hydrogen] Welding of Light Metals.** F. Rosenberg (*Aluminium*, 1937, 19, (4), 255-260).—Methods of making welded joints in light metal alloys using a tungsten arc surrounded by hydrogen are described, and many types of joints are illustrated. The advantages of the process are discussed.—A. R. P.

**Results, Experiments, and Possibilities in the Arc-Welding of Aluminium.** H. H. Fliess (*Machines*, 1937, (June), 28-31).—Given a reliable type of aluminium electrode, defective arc welds in aluminium must be due either to inadequate preparation or poor execution. Directions are given for certain types of work, with special reference to obviating oxide inclusions. Suitable dimensions of electrodes and current densities are tabulated for various thicknesses of material. The results of tensile and bending tests on welded aluminium sheet are also tabulated. Those of tearing tests are discussed, and examples of welds in aluminium and Silumin are illustrated.—P. R.

**Qualifying Welders of Silicon Bronze According to Paragraph 69 of the A.S.M.E. Unfred Pressure Vessel Code.** Charles W. Reid (*Weld. J. (J. Amer. Weld. Soc.)*, 1937, 16, (3), 5-8).—S. G.

**A Device to Aid Welding of Long Monel Sheets.** W. F. Sitler (*Weld. J. (J. Amer. Weld. Soc.)*, 1937, 16, (4), 6).—Describes a wedge clamping device to preserve the correct gap for butt-welding and to reduce buckling.—H. W. G. H.

**Steel Hard-Facing Procedure.** E. E. le Van (*Weld. J. (J. Amer. Weld. Soc.)*, 1937, 16, (4), 32–36; also *Rev. soud. autogène*, 1937, 29, (278), 98–101; and *Oxy-Acetylene Tips*, 1937, 16, (4), 77–82).—Instructions are given for applying Stellite by oxy-acetylene.—H. W. G. H.

**Oxy-Acetylene Welding of Sheet Metals.** C. G. Bainbridge (*Sheet Metal Ind.*, 1937, 11, (118), 217–220; and *Weld. J. (J. Amer. Weld. Soc.)*, 1937, 16, (4), 14–17).—The preparation of the sheets, blowpipe technique, and the use of jigs and clamps are discussed.—H. W. G. H.

**Oxy-Acetylene Welded Pipe Joints—Scope, Utility, and Economics.** T. W. Greene (*Metal Progress*, 1937, 32, (1), 36–41).—Acetylene welding is now successfully applied to pipes of brass, copper, aluminium, Monel metal, nickel, and lead, whilst galvanized pipes are assembled by bronze welding. The limitations of the process depend on the type of material. Recent advances in technique and fittings are briefly described.—P. R.

**Designing Welded Chemical Equipment.** W. Spraragen (*Indust. and Eng. Chem.*, 1937, 29, (4), 366–372).—A number of chemical processes owe their efficiency and very existence to a combination of high temperature and pressure made possible economically by welded vessels of one kind or another. The development of designs for welding, materials used for resistance to corrosion and for high and low temperatures, are discussed. The working stresses are based on data which vary with the kind of service to which parts will be subjected. Butt and fillet welds are used in making a hundred different types of joint in welded structures. Unit design stresses in such welds, economics of welding, technique, methods of relieving weld stresses, welding operators and processes, as well as certain specific examples of welded structures, are described and illustrated.—F. J.

**The Control of Welds.** R. Salelles (*Rev. soud. autogène*, 1937, 29, (277), 83–87).—A system of control should take into account the weldability of the parent metal, the quality of the filler rod, and the competence of the operator. Control of the human element presents the most difficulty, but it can be effected by routine destructive tests on samples, welded before and during the fabrication of an important piece of work, and by visual supervision. Non-destructive tests on the finished article are thought to be of less value.

—H. W. G. H.

**Welding and Welding Rods.** J. Sack (*Philips Tech. Rev.*, 1937, 2, (5), 129–135).—Brief outlines, with diagrammatic sketches, are given of the methods of arc welding introduced by Benardos, Zerener, Slavianoff, Alexander, and Langmuir. The results of a number of fairly recent investigations are quoted to show that when bare arc welding rods are used, the welding actually takes place in an atmosphere of “atomic air.” Thus the welded metal becomes contaminated with nitrogen and oxygen, with the result that it is liable to have inferior mechanical properties. To obviate this, the welding rods are given a coating of paste of certain ground minerals. Experimental evidence is given to prove that this paste forms a slag and a harmless gaseous atmosphere during the welding process, which protects the metal from the “atomic air.” Other functions of the coating on the welding rod are given. The discussion is mainly concerned with the welding of ferrous materials, but most of it is also applicable to other metals.—E. V. W.

**Applications of the Oxy-Acetylene Jet in Cutting and Welding.** W. L. Faerman (*Usine*, 1936, 45, (32), 25–30; (34), 25–27).—Read before the XIIth International Congress of Acetylene and Oxy-Acetylene Welding (but not reproduced in the *Proceedings*). A review of sources of oxygen and of acetylene and of the jets in common use is followed by a note on safety

measures. A description is given of automatic cutting plant. The welding of galvanized pipes and of non-ferrous metals and alloys (light alloys, bronze, copper, and lead) is discussed briefly, and possible extensions in large-scale acetylene cutting and welding are reviewed.—P. M. C. R.

**Stress Distribution in Fillet Welds—A Review of the Literature to January 1, 1937.** A. G. Solakian and G. E. Claussen (*Weld. J. (J. Amer. Weld. Soc.)*, 1937, 16, (5), suppt., 1-24).—A review of the literature comprised in 150 references.—H. W. G. H.

## XXI.—INDUSTRIAL USES AND APPLICATIONS

(Continued from pp. 417-421.)

†**Modern Developments in the Use of Aluminium.** Hans Schmitt (*Aluminium*, 1937, 19, (4), 235-243).—Recent work on the production of very pure aluminium, the resistance welding of aluminium and non-hardenable alloys, the development of aluminium-base bearing metals, the anodic oxidation and colouring of aluminium and its alloys, and the plating of aluminium is described. The value of aluminium alloys in constructional work is discussed.—A. R. P.

**Improvement of Metallic Surfaces for Milk and Food Manufacture by the Use of Aluminium and Its Alloys.** Welter Hahn (*Milch. Zentr.*, 1937, 66, (2), 24-26; *Brit. Chem. Abs.*, 1937, [B], 387).—The advantages of using aluminium sheets and castings for fabricating milk and for food-processing and manufacturing plant are discussed. Some results are given of work on the treatment of the aluminium surface to give greater stability to corrosion.—S. G.

**Aluminium Foil as Butter-Wrapping Material.** R. Görnandt (*Milch. Zentr.*, 1937, 66, (2), 26-28; *Brit. Chem. Abs.*, 1937, [B], 388).—Butter wrapped in aluminium foil and exposed to direct sunlight and to diffused light at room and cold temperature preserved its taste and colour better than the same sample of butter wrapped in vegetable parchment. Other advantages of metal-foil packings are discussed.—S. G.

**Aluminium Flues for Gas Apparatus.** J. B[ally] (*Rev. Aluminium*, 1937, 14, (91), 715-718).—Describes the nature of the corrosion to which gas-flue materials are subjected, and recommends the use of aluminium of not less than 99.5% purity for this purpose.—J. H. W.

**Aluminium Bus-Bars.** C. H. E. Ridpath (*Elect. Ind.*, 1936, 36, (1858), 1690-1692).—Aluminium bus-bars have a greater heat-radiating surface than copper bars of equal resistance, and skin-effect losses with a.c. are slightly less. Jointing is frequently performed by first cleaning with emery after coating with vaseline, and then clamping the ends without removing the vaseline. Alternatively, mechanical clamps or butt-welding may be employed. The design of aluminium bus-bars is discussed, and some recent installations are illustrated.—J. C. C.

**Aviation in 1937. The Evolution of Landing Devices.** J. Bally (*Rev. Aluminium*, 1937, 14, (90), 669-681).—Describes and illustrates a large number of types of landing devices for aeroplanes, constructed in aluminium or magnesium alloys.—J. H. W.

**Aluminium [in Architecture].** R. W. Brooke (*Architect. Rev.*, 1937, 81, (487), 266-269).—The characteristics of the metal and its alloys, which make them suitable for use in architecture, and design considerations are reviewed. Some applications of castings, extruded sections, and sheet are described, and the uses of foil for thermal insulation and aluminium paint for protection are indicated.—H. W. G. H.

**The Construction and Maintenance of Aluminium Alloy Canoes.** — (*Rev. Aluminium*, 1937, 14, (90), 682-684).—The requirements of an

aluminium alloy for use in the construction of canoes are outlined, and the treatment that the alloy receives is briefly described.—J. H. W.

**Aluminium Parts in a Cast Iron Foundry.** J. Bally (*Rev. Aluminium*, 1937, 14, (91), 719-722).—Describes the application of a 90:10 aluminium-copper alloy in the construction of mould components in a cast iron foundry.—J. H. W.

**Aluminium Projectors in the Lighting Tour of France.** J. Bally (*Rev. Aluminium*, 1937, 14, (92), 759-764).—Describes in detail the construction of aluminium lighting projectors, and points out the advantages of aluminium and light alloys as light reflectors.—J. H. W.

**Mirrors with an Aluminium Film Obtained by Thermal Vaporization in Vacuo.** H. Damber (*Rev. Aluminium*, 1937, 14, (90), 665-668).—Aluminium-glass mirrors are made by heating aluminium in a high vacuum and allowing the vapour to condense on a perfectly polished glass surface. Such mirrors avoid the disadvantages of silvered glass mirrors, and in addition have the advantages that: (a) the reflecting surface is unalterable; (b) the reflective power is 88-90% that of silver, but is superior in the ultra-violet range; (c) they are very robust; (d) they are equally reflecting on both sides; (e) opaque or semi-transparent backing can be deposited on the mirror for certain optical or decorative purposes; (f) the opacity of the mirrors can be varied; (g) decorative designs can be obtained by interposing objects in the aluminium vapour; and (h) the aluminium can be deposited on glass, quartz, metal, or mica.—J. H. W.

**Thin Films of Aluminium Deposited on Glass. Their Use as Electric Resistance Heaters.** Bernard Long (*Rev. Aluminium*, 1937, 14, (92), 753-756).—Thin ribbons of aluminium are deposited on resistant glass by a metallizing pistol. When an electric current is passed through the ribbon, the whole apparatus is heated to a maximum temperature of 120°-150° C. The metallization can be used decoratively. In a similar manner, floor blocks are constructed of glass metallized on the underside. When a current is passed, the upper surface is heated to about 30° C.—J. H. W.

**Glass and Aluminium.** J. Bally (*Rev. Aluminium*, 1937, 14, (90), 659-664).—Owing to the similarity of their densities, specific heats, and softening (or melting) temperatures, glass is especially suitable for metallization with aluminium by means of the Schoop pistol. The method of effecting this, and the many applications of metallized glass, are described.—J. H. W.

**Aluminium Powder and Its Practical Applications.** Valde Oskarson (*Teknisk Tidsskrift*, 1937, 67, *Uppl. A-C: Kemi*, 33-37).—Discusses various industrial applications.—S. G.

**\*The Prevention of Silicosis by Metallic Aluminium. A Preliminary Report.** J. J. Denny, W. D. Robson, and Dudley A. Irwin (*Canad. Med. Assoc. J.*, 1937, 37, (1), 1-11; also *Canad. Min. Met. Bull.*, 1937, (305), 487-503; and *Trans. Canad. Inst. Min. Met.*, 1937, 40, 487-503).—The addition of small quantities of metallic aluminium dust almost completely inhibits the solubility of siliceous material in the beaker. Seven rabbits dusted with quartz to which <1% of metallic aluminium dust had been added showed practically no fibrosis, while 6 control rabbits, dusted with quartz only, showed well-developed silicosis.—S. G.

**Cobalt as a Catalyst.** Colin G. Fink (*Trans. Electrochem. Soc.*, 1937, 71, 487-492).—S. G.

**Designing Soft Copper Gaskets for High Pressure Equipment.** William L. Edwards (*Chem. and Met. Eng.*, 1937, 44, (3), 134-137).—Gaskets of copper (among other metals) are used for sealing pressure containers. High-grade copper upwards of 99% copper, is generally accepted as the best gasket material for the higher pressures. A relatively low cold flow-point is necessary, so that, under pressure, a gas-tight joint may be produced. Therefore the

copper should readily soften when annealed. Various convenient types of joint construction for flat copper gaskets for high pressures are illustrated and described. A chart is given, based on information gained through experiment, experience, knowledge of actual tests, and a study of the indeterminate factors involved, to serve as a guide for selecting the initial unit gasket pressures for different internal diameters of gaskets and for various test pressures.—F. J.

**Design of Flat Springs [Beryllium-Copper and Other Materials].** — (*Beryllium Corp. of Pennsylvania Bull. D*, 13 pp.; *Bull. B.N.F.M.R.A.*, 1937, (101)).—A good deal of useful general information on springs is summarized. Formulae for design, stress considerations (elastic and proportional limits, endurance limit, elastic hysteresis), electrical conductivity, and stability of shape are dealt with. Numerical data are given comparing the properties of beryllium-copper with those of other spring materials, e.g. steel, nickel-brass, phosphor-bronze, and brass.—S. G.

**Ageing Copper-Base Alloys.** D. Voeikov (*Novosti Tekhniki (Tech. News)*, 1937, (4), 17; *C. Abs.*, 1937, 31, 4251).—[In Russian.] Kunial A (copper containing nickel 13.5 and aluminium 2.5%) is prepared in rods 45 mm. in diameter. It becomes hard and elastic after ageing. Kunial B (nickel 6, aluminium 1.5%) is used for springs, instead of phosphor-bronze.—S. G.

**Copper and Bronze [in Architecture].** A. G. McMullen (*Architect. Rev.*, 1937, 81, (487), 262-265).—The use of sheet copper for roofing and sheathing is discussed, with some remarks on artificial patination and the development of thin "electro-sheet." 24 g. strip copper is said to be cheaper than 5 lb. lead for flashings, gutters, &c. Modern methods of jointing are shown to account for increased use of copper pipe for water supplies and sanitation. The beautiful colours and finishes available in copper alloys are pointed out, and some applications of castings, sheet, strip, and extruded sections are mentioned.—H. W. G. H.

**Copper-Lead Bearing Metals Favoured for Severe Service.** Francis G. Jenkins (*Metal Progress*, 1937, 32, (2), 145-149).—Bearings for high-speed engines must combine high resistance to fatigue and elevated temperatures with considerable compressive strength and resistance to wear. Copper-lead alloys chill-cast on a steel backing have been found especially effective. The "leaded bronze" first introduced for railway work, containing tin 10% and lead 10%, has been superseded largely by bronzes containing 25 to 50% lead and 1 to 2% nickel. Other alloying elements include phosphorus, silver, iron, and zinc: the effect of these is discussed, and the stability limits of the copper-lead emulsion are illustrated graphically.—P. R.

**Lead-Lined Equipment.** E. Mantius and H. F. Freiherr (*Indust. and Eng. Chem.*, 1937, 29, (4), 373-377).—Successful lead construction requires not only the proper design of equipment, but also the selection of the correct grade of lead. The selection, handling, and burning of lead sheet for equipment in the chemical industry are described. Such equipment includes tanks, stills, evaporators, and piping. Lead pipe may be of straight or antimonial lead, and methods of making joints are discussed. Lead equipment for handling acids includes piping and vessels made of steel, copper, &c., lined or coated with lead, the methods of applying lead to these metals being described.—F. J.

**Lead and Pewter [in Architecture].** E. L. Bird (*Architect. Rev.*, 1937, 81, (487), 269-272).—The uses of lead pipe and sheet in building, and some applications of cast lead and of pewter for ornamental purposes, are described.—H. W. G. H.

**Nickel Silver and Monel [in Architecture].** R. G. Rengert (*Architect. Rev.*, 1937, 81, (487), 265-266).—Nickel silver is used for plumbing fittings, balustrades, grilles, door handles, &c., where its colour may be preserved by occasional cleaning. The principal applications of Monel metal are in the kitchen, for table-tops, sinks, and any working surfaces.—H. W. G. H.

**Some Aspects of the Application of Nickel Alloys to the Refrigeration Industry.** J. O. Hitchcock and W. T. Griffiths (*Proc. Brit. Assoc. Refrig.*, 1936-1937, 33, 93-97; *C. Abs.*, 1937, 31, 4855).—Nickel alloys are suggested for use in the manufacture of ammonia refrigerants, as well as in circulatory mechanisms for brine, and also as linings in tanks for the refrigeration of milk, fish, and other products.—S. G.

**Permanent [“Alnico”] Magnets.** — (*Elect. Ind.*, 1937, 37, (1883), 619).—A brief account of the characteristics and uses of the permanent magnet material Alnico, containing nickel 20, aluminium 10, and cobalt 10%, the balance being iron.—J. C. C.

**Nickel as a Catalyst.** O. B. J. Fraser (*Trans. Electrochem. Soc.*, 1937, 71, 425-486).—See *Met. Abs.*, this vol., p. 268.—S. G.

**Silver for Perfumes.** C. C. Downie (*Discovery*, 1937, 18, (213), 290).—Because of its corrosion-resisting properties, silver is used for pipes, &c., in the transference of perfumes, and other volatilized liquids, to materials which must not be discoloured.—S. G.

**Tantalum and Columbium. A Review of the Present Status of Two Metals of Growing Importance.** — (*Chem. Eng. Min. Rev.*, 1937, 29, (345), 341-343).—Briefly describes the sources of supply and production of tantalum and columbium in Western Australia, and the principal uses of the metals.—J. W.

**Tin in the Brewery.** J. Raux (*Brasseur franç.*, 1937, 1, (5), 106-108; *C. Abs.*, 1937, 31, 5933).—Tin very easily produces glutino-metallic turbidities in beer, even after a very short contact; the use of tin or tin-lined pipes should therefore be avoided. As tin is attacked by both acid and alkaline antiseptics, it is impossible thoroughly to disinfect tin equipment without encountering serious glutino-metallic turbidities.—S. G.

**Zinc [in Architecture].** J. W. Knight (*Architect. Rev.*, 1937, 81, (487), 272-274).—The wide use of zinc on the Continent for roofing is contrasted with its poor reputation in Great Britain. The latter is thought to be due to differences in roof design, and to incompetent handling of the metal.—H. H.

**\*Wrappers for Processed Cheese.** Hugh L. Templeton and H. H. Sommer (*J. Dairy Sci.*, 1937, 20, (5), 231-238).—The use of phosphate emulsifying salts in processing cheese appears to accelerate the darkening of tin foil, especially if the reaction is more alkaline than  $p_H$  5.8. Metal foils still appear superior to any other type of foils as wrappers for processed cheese. For general use with all types of cheese, tin foil is probably superior to aluminium foil, but when relative costs are considered there may be types of cheese with which aluminium foil, properly coated to prevent corrosion, may offer distinct advantages.—S. G.

**The Provision of Hot Water and Central Heating Considered from the Domestic Economy Point of View.** E. Naumann (*Kleine Mitt. Vereins Wasser-, Boden- u. Lufthyg.*, 1937, 13, (1/5), 42-51).—The increase in demand for hot water installations for domestic purposes, more especially in buildings comprising many flats, and the difficulties encountered in the erection of plant owing to difficulty of securing supplies of certain metals, more especially copper and its alloys, tin, lead, and zinc, are briefly discussed. The need for purification of water supplies and methods available are mentioned.—J. S. G. T.

**Special Alloys for Pumps.** R. M. Müller (*Pumpen u. Brunnenbau, Bohrtech.*, 1936, 32, 619-623; and *Wasser u. Abwasser*, 1936, 34, 358-359).—A description is given of corrosion- and wear-resistant alloys.—S. G.

†**Thermionic Vacuum Tube Electrode Materials.** Fred P. Peters (*Trans. Electrochem. Soc.*, 1937, 71, 519-543; discussion, 543-544).—See *Met. Abs.*, this vol., p. 311.—S. G.

**Occurrence and History of the Metals Used in Architecture.** O. W. Roskill (*Architect. Rev.*, 1937, 81, (487), 253-256).—Deals with copper, iron, lead, zinc, aluminium, nickel, and tin.—H. W. G. H.

## XXII.—MISCELLANEOUS

(Continued from p. 362.)

**To the Memory of Henry Le Chatelier, 1850-1936.** — (*Rev. Mét.*, 1937, 34, (1), 1-144).—This issue is a Memorial to the late Professor Henry Le Chatelier, and contains tributes to his life, work, and personality by L. Guillet, G. Charpy, L. Guillet and A. Portevin, R. Dubrisay and G. Chaudron, E. Rengade, E. Audibert, P. Chevenard, and many other distinguished scientists of all countries.—H. S.

**The Contribution of Josiah Willard Gibbs to Electrochemistry.** Duncan A. MacInnes (*Trans. Electrochem. Soc.*, 1937, 71, 65-72).—S. G.

**The Indexing and Filing of Technical Literature.** H. N. Bassett (*Chem. and Ind.*, 1937, 56, (20), 463-465).—Difficulties associated with storing and indexing the great output of technical and trade literature are briefly discussed. For a large index, the Universal Decimal classification may be used; the system is briefly explained. For use by a private individual, a system of vertical filing and indexing in ordinary, thin card, foolscap folders, which B. has used for 20 years is recommended; the system is explained.—J. S. G. T.

**Metallurgical Dialogue.** Albert Sauveur (*Rev. Mét.*, 1937, 34, (3), 205-214; (4), 253-263; (5), 297-306; (6), 361; (7), 399-410; (8), 462-471).—Translated from a book by S. (see *Met. Abs.*, 1936, 3, 188). Conversation between a Professor and his pupil, mainly on ferrous metallurgy but touching general scientific aspects, and age-hardening.—H. S.

**Metallurgical Education.** Gilbert E. Doan (*Metal Progress*, 1937, 31, (5), 532).—D. emphasizes the necessity for a good general education for the metallurgist or engineer, and the danger of premature specialization.—P. R.

**Research—Successful and Unsuccessful.** Robert S. Archer (*Metal Progress*, 1937, 31, (3), 255-261).—A popular review of the aims and limitations of industrial research.—P. R.

**The Brown-Firth Research Laboratories.** — (*Found. Trade J.*, 1937, 56, (1080), 350-352; (1082), 389-391).—S. G.

**The Year's Work in the [B.T.H.] Research Laboratory.** — (*B.T.H. Activities*, 1937, 13, (1), 21-31).—A description is given of certain investigations carried out in the B.T.H. research laboratories. Work of a metallurgical nature is only briefly referred to, most of the article being concerned with developments in electrical engineering.—E. V. W.

**The Record of the Metal Industries in 1936.** — (*Met. Ind. (N.Y.)*, 1937, 35, (1), 2-30).—S. G.

**Raw Material Reorganization in the German Metal Industry.** Hansheinrich Pontani (*Metallgesellschaft Periodic Rev.*, 1937, (12), 23-32).—[In English.]—S. G.

**75 Years Vereinigte Deutsche Metallwerk A.G. Zweigniederlassung Basse & Selve, Altena (Westphalia), 1861-1936.** — (*Metallgesellschaft Periodic Rev.*, 1937, (12), 4-14).—[In English.]—S. G.

**Metallurgical Progress and the Electrical Industry.** L. Sanderson (*Metallurgia*, 1937, 15, (90), 187-188).—S. G.

**The History of Aluminium. Fifty Years of Aluminium Electrolysis.** A. von Zeerleder (*Aluminium*, 1936, 18, (4), 163-172).—S. G.

**The Discovery of the Exothermic Action of Aluminium for the Production of High Temperatures at the Franklin Institute in the Year 1892.** F. Lynwood Garrison (*J. Franklin Inst.*, 1937, 223, (6), 779-784).—The discovery of the exothermic action of aluminium for the production of high temperatures—the basis of the Thermit process—by Wahl, Greene, and Garrison in 1892 is interestingly told. The discovery arose in the course of work designed to produce manganese by heating pyrolusite in a stream of reducing gas. The high temperature required for the reduction was finally obtained by adding



aluminium to the crucible charge. Patent litigation with the Goldschmidt Thermit Co. is briefly reviewed.—J. S. G. T.

**Accidents by Poisoning with Chromium Compounds in Industry.** Leroux-Robert (*Bull. acad. méd.*, 1936, 116, 875-882).—S. G.

\***Atmospheric Lead Contamination from High-Temperature Lead Baths.** B. D. Tebbens (*J. Indust. Hyg.*, 1937, 19, (1), 6-11; *Brit. Chem. Abs.*, 1937, [B], 297).—The lead in the atmosphere near lead baths at 1000°-1600° F. (540°-870° C.) covered with a layer of coal or charcoal reaches toxic limits only when the bath surface is frequently agitated, the mechanical dissemination of the surface dross being mainly responsible.—S. G.

**The Parkes Desilvering Process.** C. C. Downie (*Metallurgia*, 1937, 15, (87), 93-94).—S. G.

**The Composition of Metallurgical Powders and Methods of Removing Non-Ferrous Metals from Them.** I. M. Dubrovin (*Uralskii Gosudarst., Nauch.-Issledovatel. Inst. Zvetnyim Metal., Sbornik Nauch.-Issledovatel. Rabot.*, 1935, (1), 25-56; *C. Abs.*, 1937, 31, 3839).—[In Russian.] Cottrell powders are heated at 450°-500° C., without adding carbon as a reducer, to distil out arsenic. The residue is leached with 5% sulphuric acid in a series of agitators to remove zinc. The residue from this treatment is heated at 1150°-1200° C. to remove lead and any remaining zinc.—S. G.

**Surface Films and Lubrication.** D. R. Pye (*J. Roy. Aeronaut. Soc.*, 1936, 40, (310), 754-768).—24th Wilbur Wright Memorial Lecture. Recent work concerned with the part played by surface films in lubrication is very interestingly reviewed. The treatment throughout is non-mathematical and very readable. Reference is made more especially to the work of Langmuir, Hardy, Adam, and Bowden. A bibliography of 20 references is appended.—J. S. G. T.

\***Wires Under Tension and Transverse Forces.** J. E. Doyle (*Phil. Mag.*, 1937, [vii], 23, (158), 1114-1128).—A theoretical investigation of interest in connexion with the failure of the wires in wire ropes which run over pulleys or over which loads travel as in aerial ropeways.—W. H.-R.

**Industrial Uses of Invisible Rays.** Gilbert E. Doan (*Metal Progress*, 1937, 31, (1), 56-60, 98, 100).—A review of the developing applications of radiations is accompanied by a diagram of the "ether spectrum," on which the approximate wave-lengths of the known types of radiation are indicated; diagrams of the audible, photo-electric, and radio spectra are shown on a magnified scale.—P. R.

**Training of Physicists for Industry—From the Point of View of the Educator.** Homer L. Dodge (*Amer. Physics Teacher*, 1936, 4, (4), 167-174).—S. G.

**Scientific Property.** J. W. Williamson (*J. Sci. Instruments*, 1937, 14, (3), 73-76).—Many scientific discoveries are not *per se* patentable. W. discusses interestingly the question of "scientific property," *i.e.* the notion that by his discovery the scientific discoverer has created scientific property that is peculiarly his, entitling him to share in the material gains resulting from the industrial utilization of his discovery. Reference is made, more particularly, to proposals made by (1) Raffini, (2) Gariel, and (3) the Council of the League of Nations.—J. S. G. T.

### XXIII.—BIBLIOGRAPHY

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(Continued from pp. 422-424.)

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## XXIV.—BOOK REVIEWS

(Continued from pp. 367-368.)

**Metalografia dei Bronzi d'Alluminio.** Carl Panseri. 17 × 25 cm. Pp. xvi + 614, with frontispiece and 750 illustrations. 1937. Milano: Ulrico Hoepli. (Lire 90.)

The modest title of this monograph does not fully do it justice, for it is in fact a very complete study of the history, metallography, metallurgy, technology, properties, applications, and economics of the aluminium bronzes, and it sets a high standard among contemporary books of its type, which are unfortunately none too numerous in the field of the non-ferrous metals.

As is the case with much of to-day's Italian literature on metals, the book is designed to fill a definite gap, since the existing resources in the Italian language are extremely meagre and inadequate in the circumstances of the vigorous expansion of the domestic metallurgical industry. Its thoroughness may be gauged by the fact that it is the digest of nearly 800 published contributions to the international literature of the aluminium bronzes, which are listed in the bibliographies at the end of each chapter: it contains 750 figures and 84 tables, as well as an appendix giving a survey of the existing standards covering the aluminium bronzes in different countries. The contents of the book, however, are not merely edited by the author: his own work in the research field on the aluminium bronzes has been extensive and its results are fully incorporated. Nearly all the figures and photomicrographs are original. The chapters on metallography and heat-treatment are extremely good, and richly illustrated. Some finely-produced photomicrographs in colour merit special mention.

Finally, it should be said that the book is easy reading. The fact that it is written in

Italian should not bar its usefulness, as anyone with a fair knowledge of French (or a lingering remembrance of school Latin) should be able to find it easy enough to understand.

—FREEMAN HORN.

**Zinn : Berg- und hüttenmännische Gewinnung, Verarbeitung und Verwendung.**  
 Von C. L. Mantell. Ins Deutsche übertragen und bearbeitet von W. Lidle.  
 (Monographien über Chemisch-Technische Fabrikations-Methoden, Band LVIII.) 16 × 23.5 cm. Pp. viii + 323, with 113 illustrations. 1937.  
 Halle (Saale): Wilhelm Knapp. (Foreign price, R.M. 18.75; bound, R.M. 19.90.)

Dr. Mantell's book on "Tin," published in U.S.A. in 1929, is well known. A translation for German readers is to be welcomed. The translator has modified the book to some extent, partly by providing more detailed or up-to-date information on certain aspects and partly by presenting some portions of the book in a way that is of immediate interest to German readers. Descriptions of American practice have been replaced by accounts of German practice, and discussions of economics have been re-orientated from a similar point of view, while summaries of German patents have been added. Further statistics of production, consumption, and applications of tin have been incorporated and brought up to 1933 or 1934. The section on secondary tin has been extended and almost completely revised, and useful tabulated data on the properties and applications of bronzes, white-metal bearing alloys, solders, and other tin alloys have been added.

One could wish that the process of revision had been extended to the purely scientific side of the book. Much research that has been carried out in recent years has been neglected, and this is particularly evident in the section on equilibrium diagrams of binary tin alloys.

—E. S. HEDGES.

**La Fatigue des Métaux.** Par R. Cazaud et L. Persoz. Préface de A. Caquot.  
 16 × 25 cm. Pp. viii + 190, with 121 illustrations. 1937. Paris:  
 Dunod. (Broché, 75 francs; relié, 95 francs.)

A review of the subject of fatigue is very timely, and here is an extremely good book on the matter, written by two very competent engineers. The work is designed to appeal to all concerned with the study, construction, use, and maintenance of mechanical structures. Metallurgists will find the book extremely valuable, for here the fatigue limits of metals and alloys are tabulated along with their other physical characteristics. The book is an adequate review of the subject up to the beginning of 1937. Each of its 8 chapters contains an extensive bibliography.

The book is well produced, is well printed on good paper, and is well illustrated; its price is very moderate. It is heartily commended to metallurgical students, to metallurgists generally, and to constructional and mechanical engineers.—J. S. G. THOMAS.

**Physics in Industry.** Cr. 8vo. Pp. xiv + 290, illustrated. 1937. New York: American Institute of Physics, 175 Fifth Ave. (\$1.50.)

In October 1936 the American Institute of Physics celebrated the fifth anniversary of its founding, by holding a symposium in which several leaders of industry reviewed the accomplishments of physics in their particular fields. At the same time the American Association of Physics Teachers held a closely-allied symposium on the training of physicists for industry. The various addresses delivered relating to the work of physicists in the glass, metal, oil, building, radio, aeroplane, electric power, and mechanical engineering industries, together with two addresses on the training of physicists for industry regarded from the points of view of the educator and the employer, respectively, are made available to all educationists and industrialists at a very reasonable price. Dr. K. T. Compton contributes a foreword. Metallurgists will probably be most interested in the chapters on physics in the metal, oil, aeroplane, and mechanical engineering industries: this last is entitled "Vibration in Industry."

All the various chapters are well written and make interesting reading; some have been contributed by distinguished industrialists and educationists not lacking in a sense of humour. I have enjoyed reading the book more especially as I have been an industrial physicist for the last 24 years, and yet I feel that the book does not quite hit the mark as regards the physicist in industry. The book is correctly called *Physics in Industry* and not *The Physicist in Industry*; but this is not the place to enlarge upon this subtle difference. I would conclude with a statement of three points contained in the book with which I am in complete agreement: (1) the significance and value of the physicist in industry are only very slowly being realized; (2) "the kind of mind that leads a man to choose engineering is the kind we need in applied physics" (Ives); (3) science needs an intelligent board of directors. With a small amount of such brains as are now focussed on the speed with which the neutron penetrates the nucleus of the atom, and only 2 or 3% of the money now devoted to research into the living conditions at the dawn of history, the cost of the poor man's housing to-day could be cut in half. *Verb. sap.*

—J. S. G. THOMAS.