## METALLURGICAL ABSTRACTS

(GENERAL AND NON-FERROUS)

## Volume 4

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Part 6

## I.--PROPERTIES OF METALS

(Continued from pp. 177-181.)

\*Refined Aluminium. Takayasu Harada (Suiyokwai-Shi (Trans. Min. Met. Alumni Assoc.), 1937, 9, (3), 169-174).—[In Japanese.] The refined aluminium produced by the Cie. de Produits Chimique et Electrométallurgie d'Alais (cf. Met. Abs., 1935, 2, 365, 497; 1936, 3, 69, 210, 489; this vol., p. 200) was investigated. The material was analyzed; it was found by spectroscopie analysis that it contains only traces of sodium and oxygen and no barium. It is purer than the aluminium produced in the U.S.A. by Hoope's method. The properties of the material were studied, including sp. gr., melting point, and electrical conductivity, and tensile, Erichsen, Charpy, corrosion, and anodie film tests were carried out.—S. G.

\*Aluminium Produced in Japan.-II. Takayasu Harada (Suiyokwai-Shi (Trans. Min. Met. Alumni Assoc.), 1937, 9, (3), 175-178) .-- [In Japanese.] Cf. Met. Abs., 1936, 3, 141. The incomplete removal of sodium from primary aluminium produced in Japan on an industrial scale is the cause of the difficulties met with in working it. In addition to the composition, H. studied the melting point, melting loss, and casting contraction, and also carried out tensile, hardness, and Charpy tests on castings, tensile and Erichsen tests, and tests for press work, forging and welding on plates, and electrical conductivity and tensile tests on drawn wires. In the present report results are given of corrosion tests in 3% sodium chloride, 5% sodium carbonate, 3% acetic acid, and 3% oxalic acid solutions. The sheet test-pieces dipped in these media were tested for decrease in tensile strength and elongation at the end of each week. The results show that the sodium chloride solution colours the test-pieces dark grey more markedly than the others and that the acid solutions cause spot corrosion; in general, there was little decrease in the values obtained in the tensile tests. Anodic coating adversely affects the colour and lustre and sometimes gives rise to spots. It was found, by applying to a freshly cut surface a Japanese paper dipped in saturated alcoholic solution of phenolphthalein and dried, that the spots where sodium exists are turned to crimson and the sodium distribution is shown clearly .- S. G.

\*The Energy Distribution of Photoelectrons Emitted by Calcium and Calcium Oxide [Photoelectric Work-Function of Calcium]. Israel Liben (*Phys. Rev.*, 1937, [ii], 51, (8), 642-647).—A magnetic velocity analyzer has been used to study the energy distribution of the electrons emitted by pure calcium, calcium oxide, and a number of stages intermediate between the metal and oxide, using radiation  $\lambda$  2536. The photoelectric work-function of pure calcium was 3.21 e.v. The modern electron theories do not agree with the data for calcium oxide, but for the pure metal the theories of Fowler, Dubridge, Mitchell, and Nottingham are in reasonable agreement with the energy distribution on the high energy side, but depart from the data at low energies.—W. H.-R.

\*The Specific Heat of Copper from 30° to 200° K. S. M. Dockerty (Canad. J. Research, 1937, [A], 15, (4), 59-66).—An all-metal adiabatic vacuum calorimeter was used to determine the specific heat of copper over small

† Denotes a first-class critical review.

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<sup>\*</sup> Denotes a paper describing the results of original research.

temperature intervals from  $30^{\circ}$  to  $200^{\circ}$  K. The accuracy is considered to be within 0.05% for the greater part of the range. A curve is given showing the variation with temperature of the characteristic temperature,  $\theta$ , for copper.—S. G.

\*An X-Ray Study of Preferred Orientation in Rolled Copper. (Anderson and Kehl.) See p. 240.

The Mechanical Properties of Lead. J. C. Chaston (Metal Treatment, 1937, 3, (1), 34-38).—Recrystallization of lead and its creep under load are reviewed. Attention is directed to the importance of boundary movement in the creep of polycrystalline lead and also to the retention, after small amounts of crystal slip, of amounts of work-hardening sufficient to modify very considerably the creep behaviour of the metal. It is suggested that creep of polycrystalline lead occurs normally in three stages: (1) initial rapid extension by crystal slip, ceasing as work-hardening occurs; (2) boundary flow at constant rate, commencing after slip planes have become harder than the crystal boundaries; (3) rapid yield to fracture due to progressively increasing local stresses caused by necking. Single crystals do not show the second stage; work-hardened samples, and those having a very small grainsize, do not show the first.—J. C. C.

\*The Paramagnetic Susceptibility of Lithium. S. Ramachandra Rao and S. Sriraman (*Proc. Indian Acad. Sci.*, 1937, [A], 5, (4), 343–350).—The paramagnetic susceptibility of lithium was determined by the Curie method, taking small quantities of the metal in Pyrex glass bulbs. The glass walls and the metal were well degassed before the metal was sealed in the bulbs. The susceptibilities were determined at different field strengths and in each case the susceptibility at infinite field strength was deduced by extrapolation. The mean paramagnetic susceptibility is found to be  $2 \cdot 6 \times 10^{-6}$ . This value is examined in the light of theoretical calculations of the paramagnetism of free electrons, and it is shown to be in harmony with the general scheme of the alkali elements.—S. G.

Rapid Cleaning of Mercury. H. F. Easly (Indust. and Eng. Chem. (Analyt. Edn.), 1937, 9, (2), 82).—The dirty metal is shaken for 5 minutes in a widemouthed glass-stoppered bottle with mercurous nitrate crystals and a little water. The metal is then thoroughly washed under the tap and strained through several folds of towelling.—A. R. P.

\*A Dynamical Method for the Measurement of Young's Modulus for Imperfectly Elastic Metals, and the Application of the Method to Nickel and Some of Its Alloys. R. M. Davies and I. H. Thomas (*Phil. Mag.*, 1937, [vii], 23, (154), 361-397).—A method is described for determining Young's modulus, *E*, from the natural frequency of transverse vibration of a uniform bar of the material vibrating in the fundamental mode; the bar is clamped at one end, and is loaded at the free end with a Stalloy armature. The theory of the method is discussed in detail, and the apparatus described. Values found for *E* (the units being  $10^{11}$  dynes/cm.<sup>2</sup>) are: nickel—annealed 19·37, unannealed 19·18; Monel metal—annealed 14·94, unannealed 15·57; 48% nickel-iron annealed 13·65, unannealed 15·29; Ferry—annealed 14·54, unannealed 14·01; Brightray—annealed 20·17, unannealed 15·38, unannealed 14·42; 20% nickel silver—annealed 12·45, unannealed 11·98.—W. H.-R.

\*The Tribo-Electric Properties of a Quartz-Nickel Interface Between  $120^{\circ}$ and  $-78^{\circ}$  C. P. A. Mainstone (*Phil. Mag.*, 1937, [vii], 23, (156), 702-708).— Cf. *Met. Abs.*, this vol., p. 228. The frictional charges produced on a nickel surface when rubbed with quartz were measured at  $120^{\circ}$ ,  $15^{\circ}$ , and  $-78^{\circ}$  C. in atmospheres of air and hydrogen at different gas pressures. In both atmospheres, the charges are greater at gas pressures of 5 cm. than of 60 cm.; this suggests that when appreciable quantities of gas are present, light rubbing involves layers of absorbed gas rather than solid surfaces. At gas pressures of 1 mm. and  $10^{-4}$  mm. the charges are irregular, and bear no relation to the temperature. The effects are discussed in the light of data for the absorption of gases by nickel.—W. H.-R.

\*On the Density of Liquid Selenium. S. Dobiński and J. Wesołowski (Bull. Internat. Acad. Polonaise Sci., 1936, [A], (8/9), 446-450).—[In English.] The density of selenium at any temperature t above 220° C. is given by the equation d = 3.987 - 0.0016(t - 220).—A. R. P.

\*A Note on the Dependence of Microhardness on the Speed of Cutting of Ductile Metal [Silver]. Harold C. Hodge (Metals and Alloys, 1937, 8, (3), 81-82).—The apparent average micro-hardness of pure silver increases with increase in the speed of cutting due to a time factor involved in the flow of metal. Recommendations are made for a standard specification for the micro-hardness of ductile metals.—A. R. P.

\*The Photoelectric Work-Functions of the (211) and (310) Planes of Tungsten. C. E. Mendenhall and Charles F. De Voe (*Phys. Rev.*, 1937, [ii], **51**, (5), 346– 349).—The photoelectric emission from a (211) and a (310) plane on a tungsten crystal was determined, and the work-function obtained by Fowler's method. Owing to the long time needed to outgas the whole crystal, the experiments were made on clean surfaces at different times after the crystal had been flashed at about 2200° C., and the results extrapolated to zero time after flashing. The work-functions at the absolute zero for the (211) and (310) planes are 4:50 and 4:35 v., respectively.—W. H.-R.

\*Contact Potential Between Filaments in Vacuum by Kelvin Method. A. T. Waterman (*Phys. Rev.*, 1937, [ii], **51**, (1), 63).—Abstract of a paper read before the American Physical Society. Two parallel filaments constitute a condenser whose capacity is varied by vibrating one of the filaments under tension, in order to detect any unbalanced contact p.d. An a.c. of properly adjusted frequency through this filament, in the presence of an applied magnetic field, causes it to vibrate with a satisfactory amplitude while heating it to any desired temperature above 420° K. The other filament is connected to an audiofrequency amplifier, the circuits being similar to those of Zisman (Rev. Sci. Instruments, 1932, 3, 367) in measuring contact p.d. between plates in air. Measurements consist in adjusting a measured potential applied to the electrical mid-point of the vibrating filament until the amplifier indicates that the contact potential is completely balanced out. With proper adjustment, disturbance from the applied a.c. is eliminated. The films are electrically shielded from external disturbance, appreciable contact p.d. between shield and filaments being compensated. To reduce the tension on the filaments while outgassing and to restore it for vibration, a system of glass levers, bearings, cams, and iron armatures, encased in glass, are operated by magnets from outside the tube. Although not to be regarded as final, measurements so far made, employing tungsten filaments, indicate an increase with temperature in the work-function of tungsten of approx.  $6 \times 10^{-5}$  v./° C.-S. G.

\*Method for the Production of Metal Single Crystals Between 20  $\mu$  and 0.2  $\mu$ . J. Rinchart and A. Goctz (*Phys. Rev.*, 1937, [ii], 51, (2), 147).—Abstract of a paper read before the American Physical Society. In order to measure the dependence of electromagnetic properties of metals on their size, it is necessary to avoid plastic deformation during the production of the crystal. As the methods used in general for the production of fine single crystalline powders consisted of the application of mechanical methods, such as grinding, &c., a new method was developed by which the metal is sprayed while liquid by the application of a high pressure gas (100–150 atm.) at a temperature above the melting point of the metal. The resulting metal dust crystallizes while hovering in an oil fog. The particles are then separated by sedimentation and centrifuging in order to obtain suspensions of crystals of equal size, which are then oriented crystallographically parallel, after the method of Goetz and Faessler.—S. G.

\*Theory of Fracture of Brittle Materials. Adolf Smekal (Ergeb. exakt. Naturwiss., 1936, 15, 106-188).—See Met. Abs., this vol., p. 79.—S. G.

\*Distortion of Grains by Fatigue and Static Stressing. (Barrett.) See p. 240.

The Problem of Gases in Metals. G. Chaudron (Bull. Assoc. Tech. Fonderie, 1937, 11, (1), 4-11; discussion, 11-13).—A description is given of a new cold degassing process of general application for determination of gas content of metals. Metals to be treated are made the cathode of a discharge tube operating at 5000 to 150,000 v. No appreciable heating occurs, and rapid extraction is possible only with thin specimens or with metals permitting rapid diffusion of gas. A modified apparatus allows induction heating of the specimen. Figures are given for the nitrogen content of aluminium and calcium. In the case of aluminium, the values are greater than those obtained by Kjeldahl's method, which does not account for occluded gas.—W. D. J.

\*Crystal Growth Across Interfaces. A Note on Experimental Evidence. B. S. Barham and W. D. Jones (*Met. Ind.* (*Lond.*), 1937, 50, (6), 181–182).— A tin ingot, after being worked so as to close up an internal cavity, was annealed at 180° C. for 1 hr. Crystal growth occurred across the interface, a trace of the crack, however, remaining in many parts across the new crystal. Grain-growth occurred also across the interface of two gold specimens, previously polished, etched, annealed, and pressed together under 3 tons/in.<sup>2</sup>, when they were heated to 800° C. for 10 minutes. When the specimens were not etched after polishing, no grain growth occurred, presumably owing to the interference of a film of magnesia. Thus, Rosenhain's intercrystalline cement does not appear necessary for crystal growth, and Tammann's views that intercrystalline films of impurities hinder grain growth are supported. (See abstract below).—J. C. C.

Crystal Growth Across Interfaces. E. H. Bucknall. B. S. Barham and W. D. Jones (*Met. Ind.* (*Lond.*), 1937, 50, (8), 241; (9), 280).—Correspondence on an article by B. and J.; see preceding abstract.—S. G.

Metals Do Not "Crystallize" Under Vibration. — (U.S. Bur. Stand. Letter Circular 486, 1937, 2 pp.).—An explanation in simple language of fracture under fatigue.—W. D. J.

On Fundamentally Wrong Methods for Establishing Non-Existence of Polymorphism. A. L. Th. Moesveld (Z. physikal. Chem., 1937, [A], 178, (6), 455-467).—See Met. Abs., this vol., p. 180.—S. G.

\*On the Vibrational Spectrum of a Three-Dimensional Lattice. M. Blackman (*Proc. Roy. Soc.*, 1937, [A], **159**, (898), 416-431).—Although not directly applicable to metals, this development of specific heat theory should be noted.—W. H.-R.

\*The Effect of Heat-Treatment on the Tribo-Electric Properties of Quartz and of Metals. P. A. Mainstone (*Phil. Mag.*, 1937, [vii], 23, (155), 620-628).— The cause of the variations in the tribo-electric properties of metals when rubbed with quartz was investigated. The tribo-electric property of quartz is usually positive with respect to most metals (*i.e.* the metal acquires a negative charge when rubbed with quartz). After heating the quartz above  $350^{\circ}$  C. at a pressure of  $10^{-4}$  mm., the sign of the effect is reversed, and all attempts to prevent the reversal by the removal of impurities have failed. The metals tin, bismuth, zinc, and aluminium when-heated almost to their melting points, and the metals copper, nickel, and palladium when heated to  $800^{\circ}$  C. show no reversal.—W. H.-R.

\*[Electrical] Resistance of Monovalent Metals. E. L. Peterson and L. W. Nordheim (*Phys. Rev.*, 1937, [ii], **51**, (5), 355–364).—The theory of electrical resistance in metals is developed by a method in which the resistivity is

regarded as due to the fact that in a distorted crystal (*i.e.* a crystal in which the perfect regularity is upset by the thermal agitation of the atoms) the proper solutions are not of the type of progressive waves, but linear combinations of these. The transition probabilities can be worked out under the assumptions that the charge distribution of the conduction electrons almost compensates the electrostatic potential due to the shift of the ions from their equilibrium positions, and that in the undistorted crystal the periodic factor  $u_k$  in the wave functions  $u_k \exp$ .  $(2\pi i \mathbf{kR})$  does not depend sensibly on the wave number k. In this case only the average electronic density and not the exact form of the wave functions and potentials is found to be relevant. Calculations are made for sodium, potassium, copper, silver, and gold, and the agreement with fact is better than in previous theories.

-W. H.-R.

\*Superconducting Cylinders. D. Shoenberg (Proc. Cambridge Phil. Soc., 1937, 23, (2), 260-276).-The magnetization curves of short tin, lead, and tantalum cylinders were measured by the force method, and it was shown that, although for tin there was no appreciable hysteresis in the transverse position, there was a very marked hysteresis in the longitudinal position, of the same form at different temperatures but depending on the sharpness of the cylinder rims. Lead and tantalum showed additional temperature dependent features which could be attributed to impurities. The hysteresis due to shape in the longitudinal cylinder is analogous to the hysteresis of alloy ellipsoids, in that the magnetization for a given field always lies within a certain boundary curve and varies " classically " within this boundary. This analogy suggests that the mechanism of the shape hysteresis for a pure superconductor may be similar to the sponge mechanism proposed by Mendelssohn for alloys, but it is also possible that the hysteresis is due to the formation of macroscopic superconducting rings. The considerations which fix the boundary curve are probably similar to those in the superconducting ring, and in this connection some new measurements on a lead ring arc reported. A discussion is given of the time lag between magnetization and field, and it is suggested that this is not a primary phenomenon.—S. G. On the Nature of the Superconducting State. F. London (*Phys. Rev.*, 1937,

On the Nature of the Superconducting State. F. London (*Phys. Rev.*, 1937, [ii], 51, (8), 678-679).—A theoretical note. The work of Slater (*Met. Abs.*, this vol., p. 134) is discussed in the light of L.'s theories that superconductivity is due to a special electronic state with the characteristics : (1) that its energy lies lower than, and is separated by a finite interval from the ordinary Bloch states; (2) that its eigenfunction is non-degenerate and in a weak magnetic field it undergoes no stronger perturbations than are proportional to  $H^2$ . In this mechanism of conduction the transport of electricity is not based, as usually, on progressive waves or wave packets, but on stationary waves. By these a transport of electricity can only be effected in the presence of a magnetic field, and this is L.'s assertion as to the nature of supercurrents.—W. H.-R.

\*On the Behaviour of a Certain Superconducting Circuit. Richard J. Duffin (*Phys. Rev.*, 1937, [ii], **51**, (7), 575–577).—Theoretical. A circuit is considered consisting of a hollow wire of one superconducting metal and a return wire of another superconducting metal inside the first wire. The application of thermodynamics leads to an equation equivalent to the latent heat relation of Gorter and Casimir (*Met. Abs.*, 1934, 1, 561).—W. H.-R.

\*Particle Size and Magnetic Susceptibility S. S. Bhatnagar, M. R. Verma, and M. Anwar-ul-Haq (Kolloid-Z., 1937, 78, (1), 9-18; Sci. Abs., 1937, [A], 40, 321).—The magnetic susceptibilities of lead, copper, sulphur, selenium, tellurium, bismuth, and antimony were measured for particles of dimensions of about  $0.4 \mu$ . In all cases examined it was found that the susceptibilities were equal to that of the compact element, after impurities such as oxides, hydroxides, and carbonates had been removed. Therefore no changes of magnetic susceptibility had occurred by agglomeration of purified particles of lead, bismuth, and antimony, and consequently particle size must not influence this property. Measurements were also made for the leaf and dark modifications of lead, and gave the same result as for the compact metal. It was also shown that the conclusions of Rao (*Met. Abs.*, 1936, 3, 295) with respect to copper, bismuth, and antimony are not valid, since Rao probably had ignored the influence of inclusions in copper and the formation of oxides and hydroxides in bismuth and antimony. Further, his citation from the work of Prins that antimony may be amorphous in the colloidal state is not contained in the original text. The conclusion is reached that an alteration of the micro-crystalline structure is solely responsible for the change of magnetic properties, and that the purity of the materials investigated is the all-important factor.

-S. G.

\*A Note on Magnetostriction in [Metals Assuming a] Degenerate Electron Gas. D. V. Gogate (*Phil. Mag.*, 1937, [vii], 23, (154), 487-490).—Theoretical. The electron theory of paramagnetic susceptibility and magnetostriction is developed.—W. H.-R.

## **II.**—**PROPERTIES OF ALLOYS**

#### (Continued from pp. 181-187.)

\*The Effect of Impurities on the Ductility, Electrical Conductivity, and Mechanical Properties of Aluminium. M. P. Slavinskiy, I. N. Kolmikov, and A. E. Vol (*Metallurg (Metallurgist*), 1936, (11), 16-24).—[In Russian.] The effect of tin, copper, zinc, lead, magnesium, silicon, and iron on aluminium was investigated. The mechanical strength of aluminium, intended for electrical conductors, is increased by addition of up to 1% of copper, magnesium, or iron, or up to 2% of silicon. Magnesium is most effective, but silicon is most suitable as it produces a maximum increase in mechanical properties per unit decrease in electrical conductivity. The order of suitability of the additions is : silicon, copper, magnesium, and iron; tin, zinc, and lead have little or no effect.—N. A.

\*Alloys of Aluminium with Copper and Tin. M. I. Zamotorin (Metallurg (Metallurgist), 1936, (11), 103-108).—[In Russian.] The ternary cutectic in the aluminium-copper-tin system is close to the tin corner. The solubility of tin in aluminium increases with increasing copper content, reaching 5% with 10% copper, but the solubility of copper in aluminium is reduced by the presence of tin. Up to 5% of copper increases the tensile strength, but more reduces it again. Up to 2-5% tin has little effect on the tensile strength, but decreases the clongation and reduction in area; with more than 2-5% tin the tensile strength is reduced. Copper increases the hardness, and, up to 1%, the wear hardness by drilling, while tin up to 10% also increases the corrosion is seriously reduced. Copper also has a deleterious effect on the cornes of the alloys.—N. A.

\*Strain Measurements on Small Duralumin Box Beams in Bending. Paul Kuhn (Tech. Notes Nat. Advis. Citee. Aeronautics, 1937, (588), 23 pp.).— Strain-gauge measurements made on the tension side of 5 small rectangular box beams made of sheet Duralumin show that, within the test range, the tension cover may be considered as being fully effective, but that there may be unaccountable variations of  $\pm$  5% from the calculated stresses on sheets 0.023–0.044 in. thick and of  $\pm$  10% on sheets 0.014 in. thick at any given point on the beam.—A. R. P.

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The Precipitation-Hardening of Aluminium [Alloy] Castings. — von Zeerleder (Aluminium, 1937, 19, (2), 53-57; discussion, 70-71).—To obtain the best precipitation-hardening effects in cast aluminium alloys a fine-grained structure, such as is obtained by chill-casting, or preferably die-casting, is necessary. The casting should then be annealed at just below the solidus temperature, preferably in a salt-bath or in a furnace with forced aircirculation. Rapid transfer to the quenching bath is essential. Suitable apparatus for these operations is described and illustrated. Ageing after quenching is effected at 100°-200° C. according to the alloy. After treatment in this way Anticorodal castings attain a tensile strength of over 16 kg./mm.<sup>2</sup> at 200° C. with a yield-point of 14 kg./mm.<sup>2</sup> and an elongation of 2-3%.—A. R. P.

\*Contribution to the Question of Hardening Magnesium-Aluminium Casting Alloys Containing  $Mg_2Si$ . E. Kröner (*Aluminium*, 1937, 19, (2), 58-65; discussion, 70-71).—Attempts to obtain hardenable alloys containing relatively high percentages of magnesium and silicon showed that alloys of eutectic or slightly hypoeutectic composition cannot be expected to be useful, since even with much higher casting temperatures than are practicable, the Mg<sub>2</sub>Si crystals of the quasi-binary cutectic cannot be sufficiently refined to produce a desirable structure. With an excess of magnesium above the eutectic composition the effects producible by age-hardening are appreciably reduced. Most of the alloys examined were relatively brittle and no improvement was obtained by addition of 0.3% of cerium; slightly harder alloys were obtained by adding cerium 0.3, zinc 0.8, and manganese 0.8% to the 3% magnesium (as Mg<sub>2</sub>Si) alloy, but no useful age-hardening effect was produced.—A. R. P.

The Effect of Heat-Treatment on Silumin Castings With and Without Magnesium. G. Gürtler (Aluminium, 1937, 19, (2), 66-70; discussion, 70-71).—Addition of 0.3-0.5% magnesium to Silumin has no effect on the static tensile properties of the cast, soft annealed, or quenched (from 530° C.) metal, but increases the hardness and strength considerably on ageing the quenched metal at 150° C. for 20 hrs. The hardening effect of magnesium is greater in chill-castings than in sand-castings, owing to the more regular distribution and finer grain-size of the Mg<sub>2</sub>Si. Age-hardening treatment has no effect whatever on the endurance limit of the metal either with or without magnesium, the same values being obtained in both cases for quenched as for aged specimens.—A. R. P.

\*Influence of the Addition of Titanium to Aluminium-Magnesium Alloys. G. Komovski, I. Romantsov, and A. Maksimov (Legkie Metalli (Light Metals), 1936, (12), 40-43).—[In Russian.] An investigation of the tensile strength of cast aluminium alloys with magnesium (2-12%), manganese (0·1-0·6%), and titanium (0·1-0·5%) showed that an alloy with magnesium 8, titanium 0·4, and manganese 0·4% had the maximum tensile strength.—D. N. S. \*Optical Changes in Freshly Evaporated Aluminium-Magnesium Films.

\*Optical Changes in Freshly Evaporated Aluminium-Magnesium Films. Hiram W. Edwards and Robert P. Petersen (J. Opt. Soc. Amer., 1937, 27, (2), 87-91).—Mirrors made by evaporation of aluminium or aluminiummagnesium alloy are better suited than silver for use as semi-transparent mirrors used in commercial 3-beam colour photography. It is difficult, however, to produce a film of specified transmissivity, and changes appear to occur with time. Experimental measurements were made with white light, during and after deposition of the film. In vacuum there was a small rapid decrease in reflectivity and increase in transmissivity, and a similar change occurred during admission of air or other gases into the vacuum chamber. A third change is slower and the final value of reflection coefficient is approached asymptotically. The changes in a typical case were 8, 5, and 10%, respectively, for an initial 58% reflection.—R. G. \*Hardness and Electrical Conductivity of the Aluminium-Tin System. M. I. Zamotorin (*Trudi Leningradskogo Industrialnogo Instituta (Trans. Leningrad Indust. Inst.*), 1936, (4), 23-25).—[In Russian.] Hardness and electrical conductivity measurements on tin-aluminium alloys indicate a limited mutual solid solubility of the two components, aluminium dissolving up to 2% tin, and tin less than 0.5% aluminium.—N. A.

\*The Effect of Aluminium on the Properties of Beryllium-Copper Alloys. I. A. Amsterdamskiy (Metallurg (Metallurgist), 1936, (11), 90-102).-[In Russian.] Addition of aluminium to beryllium-copper alloys reduces the  $\alpha$ -range by decreasing the solid solubility of beryllium; with 5% aluminium this does not exceed 0.8-0.9% at 850° C., the alloy with aluminium 5 and beryllium 2% consisting almost wholly of  $\beta$  at this temperature. With more than 2% aluminium the alloy must be heated to progressively higher temperatures to obtain homogeneous a. These facts indicate that aluminium reduces the hardening effect obtainable with beryllium, but induces ageing to take place with a lower beryllium content. Aluminium increases the hardness of beryllium-copper alloys, especially on quenching; the tensile strength of alloys quenched from 800° C. is increased by 6-7 kg./mm.<sup>2</sup> for every 1% of aluminium up to 4%. The 2% beryllium alloy has a tensile strength of 43-48 kg./mm.<sup>2</sup> and an elongation of 55-58% when the aluminium content is 0-0.4%; with 2% aluminium the corresponding values are 57 kg./mm.2 and 40%; with 3% aluminium 60 kg./mm.<sup>2</sup> and 15%; with 4% aluminium 70 kg./mm.<sup>2</sup> and 7%; and with 5% aluminium 55-60 kg./mm.<sup>2</sup> and 2-3%, after quenching from 800° C. After ageing the greatest tensile strength is obtained with 0.4-0.8% aluminium (124 kg./mm.<sup>2</sup> with 5–6% elongation), and the greatest Brinell hard-ness (410–415) with 5% aluminium. The best ageing temperature is 290°–300°C. for 6-14 hrs. For practical purposes 0.8-1.0% aluminium in the 2% beryllium alloy is considered desirable .- N. A.

\*The Effect of Lead on the Properties of Copper-Beryllium Alloys. I. A. Amsterdamskiy (*Metallurg (Metallurgist*), 1936, (12), 111-115).—[In Russian.] Lead forms no solid solution in beryllium-copper alloys, but separates along the grain boundaries. When these are uniformly distributed, the reduction in area is only slightly reduced. At high temperatures, melting of the lead inclusions decreases the cohesion between the grains. Lead also reduces the ductility in cold-working. In practice, the lead content should not exceed 0.02-0.03%, since even 0.05% lead prevents hot-working.—N. A.

Nickel in American Bronze Alloys. — (Nickel Bull., 1936, 9, (10), 205-208).—Describes the composition, properties, and applications of a number of modifications of bronze alloys laid down as standard by the Society of Automotive Engineers, American Foundrymen's Association, American Society for Testing Materials, &c., the modifications covering either the addition of nickel or the partial substitution of nickel for tin.—J. H. W.

\*The Phenomenon of Inverse Segregation in Brasses. M. P. Slavinskiy, N. I. Zedin, A. K. Konstantinov, and P. G. Kusmarzov (*Trudi Leningradskogo Industrialnogo Instituta (Trans. Leningrad Indust. Inst.*), 1936, (4), 3-9).— [In Russian.] Inverse segregation in commercial brass ingots is characterized by exudations from the ingot surface as a result of molten metal being expressed through capillaries from the interior of the ingot during cooling. The composition of the exuded beads varies at different points of the ingot surface, since the molten metal passing through the capillaries absorbs different amounts of the crystals past which it flows.—N. A.

The Season-Cracking of Brass. A Review of Present Knowledge. J. D. Jevons (*Met. Ind. (Lond.)*, 1937, 50, (15), 431-436).—A review. Factors which influence season-cracking are the chemical composition of the metal, the magnitude of the residual internal stress, the nature of the surroundings, and the shape of the article. The mercurous nitrate test reveals internal stresses,

but its significance as a guide to behaviour during service has received different interpretations by different workers. Low-temperature annealing for stress relief is preferably carried out in air circulation furnaces.—J. C. C.

Manganese Bronze. A Correlated Abstract. F. R. Hensel (*Trans. Amer. Found. Assoc.*, 1936, 44, 457-478; discussion, 492-495; also Met. Ind. (Lond.), 1936, 49, (7), 158-163; and Canad. Chem. and Met., 1936, 20, (7), 230-232, 235; (8), 261-262).—The physical properties, compositions, and microstructures, of manganese bronzes are discussed, and recommendations are made for melting, control of compositions, choice of fluxes, use of scrap, casting, gating, feeding, and casting temperature. A bibliography of 68 references is included. The discussion refers to the use of vanadium in these alloys.—W. D. J.

Silicon Brass. N. Orlov (Novosti Tekhniki (Tech. News), 1936, (32-33), 12-13; C. Abs., 1937, 31, 2153).—[In Russian.] The properties of alloys containing copper 79-81, silicon  $3\cdot5-3\cdot8$ , and  $3\cdot0-3\cdot3$ , iron not more than  $0\cdot3$  and  $0\cdot6\%$ , and the remainder zine are : breaking strength 50 and 40 kg./mm.<sup>2</sup>, limit of proportionality 18 kg./mm.<sup>2</sup>, elongation 20 and 11%, tenacity 8.8 and 3 kg./cm.<sup>2</sup>, and Brinell hardness 120, respectively.—S. G.

\*Notes on the Hardness and Conductivity of Heat-Treated Copper Castings Alloyed with Zirconium and Beryllium. G. F. Comstock and R. E. Bannon (Metals and Alloys, 1937, 8, (4), 106–109).—Alloys of copper with 1.4-3.24%zirconium were prepared by adding a 15% zirconium-copper alloy to molten copper. After quenching from 900° C., the alloys had Rockwell E hardnesses of 53–71, which increased to 76-85 after heating at 450° C. for 24 hrs.; in this state the conductivity was 75-55% according to the zirconium content. When 1.5-2% of beryllium was added to the alloys, the hardness after quenching was 85-88, and increased to about 116 after reheating at 400° C. for 24 hrs.; the conductivity of the hardened alloys was, however, only about 36% of that of copper. Addition of zirconium to berylliumcopper alloys increases the precipitation-hardness only slightly, but is beneficial in restraining softening at high temperatures.—A. R. P.

Metals and Alloys in the Printing Industry.—I-IV. B. W. Gonser and S. Epstein (*Metals and Alloys*, 1937, 8, (1), 3-7; (2), 59-62; (3) 63-70, 72; (4), 117-121).—An illustrated review.—A. R. P.

Drosses in Lead Smelters [Lead-Copper Arsenide Alloys]. C. M. Dice, G. L. Oldright, and T. B. Brighton (*Trans. Amer. Inst. Min. Met. Eng.*, 1936, 121, 127-159).—From a discussion of the equilibria in metal-metal sulphide systems, a scheme is suggested for the treatment of drosses obtained by liquating and softening erude lead from the blast-furnace. Data are also given on lead-copper arsenide alloys; the minimum lead content of these is 3-4% when the Cu: As ratio is  $3\cdot4-4\cdot1: 1.-A$ . R. P.

\*A Study of the Drosses from Lead Blast-Furnaces. Gerald U. Greene (*Trans. Amer. Inst. Min. Met. Eng.*, 1936, 121, 171–190; discussion, 190–193).—To study the constituents and behaviour of speisses, synthetic alloys of lead with copper, nickel, and iron arsenides and antimonides were examined micrographically and by X-rays. The compounds usually found in speisses produced in smelting operations are Fc<sub>2</sub>As, NiAs, Cu<sub>3</sub>As, and Cu<sub>3</sub>Sb. NiAs is hexagonal, Fc<sub>2</sub>As face-centred tetragonal, 'and Cu<sub>3</sub>As body-centred tetragonal. Cu<sub>3</sub>As retains about 6.6% lead if the mixture is allowed to cool slowly and the other compounds much less, but the presence of several compounds together with sulphides in a mixture may considerably increase the amount of retained lead.—A. R. P.

\*The Magnetic Properties of Manganese Amalgams. L. F. Bates and L. C. Tai (*Proc. Phys. Soc.*, 1937, 49, (3), 230–236).—The variations with temperature of the magnetic susceptibilities of manganese amalgams containing, respectively, 0.0016, 0.008, 0.016, and 0.03 grm. of manganese per

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100 grm. of mercury were determined at  $15^{\circ}-350^{\circ}$  C. The amalgams exhibit pronounced temperature hysteresis of their magnetic properties, and it is suggested that manganese becomes more paramagnetic with increase of temperature, until, in the case of the more concentrated amalgams, a steady state is reached. The results are discussed in terms of "local order" in alloys. It has been subsequently found that when a manganese amalgam is violently shaken and then allowed to stand, an intensely magnetic constituent very quickly rushes to the surface of the amalgam.—J. S. G. T.

\*On the Nickel-Aluminium Equilibrium Diagram. Hideo Nishimura and Satoshi Watanabe (Suiyokwai-Shi (Trans. Min. Met. Alumni Assoc.), 1936, 9, (3), 153-158).—[In Japanese.] The nickel end of the system nickel-aluminium was studied thermally and microscopically, and a new diagram for this part of the system is published. Within the range of composition investigated (0-20% aluminium) it is found that  $\beta$  (Ni<sub>4</sub>Al) forms from the melt at 10.3% aluminium and that it undergoes the eutectoid transformation :  $\beta \leq \alpha + \gamma$ . Two eutectic reactions have also  $1000^{\circ}$  C.

been observed at about 9.5% aluminium, respectively: Liq.  $\pm \alpha + \beta$  and Liq.  $\pm \beta + \gamma$ .—S. G.

1300° C.

\*An X-Ray Analysis of the Nickel-Aluminium System. (Bradley and Taylor.) See p. 241.

\*On the Course of the Transformations in the Irreversible Iron-Nickel Alloys. Franz Wever and Heinrich Lange (Mitt. K.W.-Inst. Eisenforschung, 1936, 18, (15), 217-225).—Magnetic investigations of the transformations in the irreversible nickel-iron alloys showed that no change occurs in the nickel content of the phases during the  $\gamma-\alpha$  transformation, but that the  $\alpha-\gamma$  transformation is accompanied by concentration changes provided that the alloy is maintained at constant or very slowly rising temperature for sufficient time. X-ray examination of the  $\alpha-\gamma$  transformation in the 24.9% nickel alloy showed that when this alloy is annealed in the heterogeneous temperature range a face-centred lattice with a larger parameter than that calculated from Vegard's rule is formed.—A. R. P.

\*An X-Ray Investigation of Pure Iron-Nickel Alloys. III.—The Thermal Expansion of Alloys Rich in Iron. E. A. Owen and E. L. Yates (*Proc. Phys. Soc.*, 1937, 49, (3), 307-314).—See also *Met. Abs.*, this vol., pp. 40 and 142. The parameters of pure iron and iron-nickel alloys in the  $\alpha$ -phase at room temperature to 600° C. were determined and the coeffs. of thermal expansion of the alloys containing 0–16.4% (atomic) of nickel deduced. The thermal expansion of iron of 99.97% purity was determined at 0°-500° C. The lattice parameter of iron at 15° C. was found to be 2.8605<sub>0</sub> A., and its coeff. of thermal expansion ( $\varepsilon$ ) at 15° C. is 10.7 × 10<sup>-6</sup> per ° C. At all temperatures, the addition of nickel to iron at first decreases and then increases the value of  $\varepsilon$ .—J. S. G. T.

\*An X-Ray Investigation of Pure Iron-Nickel Alloys. IV.—The Variation of Lattice Parameter with Composition. E. A. Owen, E. L. Yates, and A. H. Sully (*Proc. Phys. Soc.*, 1937, 49, (3), 315–322).—Variations of the latticeparameter of 20 alloys in the  $\gamma$ -phase containing 23–97% (atomic) of nickel, and 4 alloys in the  $\alpha$ -phase containing 3-16% (atomic) of nickel were determined at 15°–600° C. At room temperature, when iron is added to nickel, the nickel lattice expands almost linearly with atomic composition until the lattice parameter attains a maximum value of 3-5895 A. for an alloy containing 39% (atomic) of nickel. On further addition of iron, the lattice contracts. The densities of the alloys through the whole range from 0 to 100% nickel are given.—J. S. G. T. \*An X-Ray Investigation of Pure Iron-Nickel Alloys. V.—The Variation of Thermal Expansion with Composition. E. A. Owen, E. L. Yates, and A. H. Sully (*Proc. Phys. Soc.*, 1937, 49, (3), 323-325).—The variation of the thermal coeff. of expansion with composition of the  $\gamma$  alloys, deduced from measurements of crystal parameters, agrees, in the main, with that found by Guillaume and by Chevenard. Certain divergencies are possibly due to difference of purity of the metal used by the different investigators.—J. S. G. T.

\*The Heat of Formation of Nickel-Silicon Alloys and Melts. Willy Oelsen and Hans-Otto von Samson-Himmelstjerna (*Mitt. K.W.-Inst. Eisenforschung*, 1937, 18, (9), 131-133).—The heat of formation-composition curve of the silicon-nickel system shows two marked points of inflection corresponding with the compositions of Ni<sub>2</sub>Si and NiSi. The heat of formation of the former is 33.6, and that of the latter 20.6 kg.-cal./grm.-mol. at room temperature. The heat of formation of the other compounds in the system can be calculated additively from these values. The heat content of molten alloys at 1600° C. is much lower than that calculated for simple mixtures; the composition-heat content curve shows well-marked maxima at Ni<sub>2</sub>Si and NiSi and minima at Ni<sub>3</sub>Si and Ni<sub>3</sub>Si<sub>2</sub>, indicating that the two first-named compounds are dissociated on melting. At 1600° C. the maximum heat of formation occurs at Ni<sub>3</sub>Si<sub>2</sub> (14 kg.-cal./grm.-atom); the values for all compositions are higher than those for the solid state showing that the silicides of nickel are very stable compounds.—A. R. P.

\*A Dynamical Method for the Measurement of Young's Modulus for Imperfectly Elastic Metals, and the Application of the Method to Nickel and Some of Its Alloys. (Davies and Thomas.) See p. 226.

\*On Osmiridium. O. E. Zveginzev (*Izvestia Sektora Platini (Ann. Sect. Platine*), 1936, 13, 123–127).—[In Russian.] Chemical and X-ray analyses of samples of osmiridium from Kuznetskiy Alatau and Northern Caucasus gave values which showed them to be naturally occurring solid solutions.—N. A.

\*Evidence of Hysteresis Between Decomposition and Re-Formation of a Homogeneous Metal Phase [in Platinum-Gold Alloy]. C. H. Johansson and O. Hagsten (Ann. Physik, 1937, [v], 28, (6), 520-527).—The transformation of a 70:30 (atomic ratio) platinum-gold alloy was followed at various ageing temperatures by measurements of the electrical resistance. The decomposition of the solid solution stable above 950° C. was most rapid between  $380^{\circ}$  and  $560^{\circ}$  C., and became much slower as the temperature was increased towards 950° C., at which point it became extraordinarily slow. Whilst the decrease in resistance ceased in 20 hrs. at  $563^{\circ}$  C. only 3% of the total decrease occurred in 30 hrs. at 890° C.—v. G.

\*The Palladium-Silver Alloys. E. J. Rode (*Izvestia Sektora Platini* (Ann. Sect. Platine), 1936, 13, 167-175).—[In Russian.] Examination of the system by means of thermal and micrographic analysis and by hardness measurements showed that the two metals form a continuous series of solid solutions. —N. A.

\*Physico-Chemical Investigation of the Platinum-Silicon System. N. M. Voronov (Izvestia Sektora Platini (Ann. Sect. Platine), 1936, 13, 145-166).— [In Russian.] The equilibrium diagram of the platinum-silicon system has been established by thermal and micrographic analysis and by hardness, electrical resistance, and e.m.f. measurements. The compounds  $Pt_sSi_2$ ,  $Pt_2Si$ , and PtSi are formed, the first as a result of a peritectic reaction, while the other two melt congruently.  $Pt_2Si$  undergoes a transformation at about 700° C. Platinum dissolves up to 1.4 atomic-% of silicon. Brittleness of platinum apparatus is produced by the brittle, readily fusible platinum silicides which are formed by merely bringing platinum in contact with silicon-containing substances at high temperatures. The diagrams of the platinum and iron groups of metals with silicon present certain anomalies.—N. A. \*Silver-Copper-Silicon Alloys. Notes on the Ageing of Silver-Rich Ones. Tracy C. Jarrett (Metals and Alloys, 1936, 7, (12), 309-313; and (summary) Metallurgia, 1937, 15, (88), 107).—Curves are given showing the change in properties on ageing silver alloys containing (a) copper 6.99, silicon 0.87%; (b) copper 3.16, silicon 0.32%; (c) copper 1.86, silicon 0.14%; and (d) copper 10, silicon 0%. The alloys were quenched from 700° C. and aged for various periods at 100°-400° C. Brinell hardness of the quenched alloys increases with increasing percentage of Cu<sub>3</sub>Si, but the final hardness obtained after ageing is about the same for all the alloys. Increase in the Cu<sub>3</sub>Si content produces an increase in tensile strength but a corresponding decrease in ductility. The electrical conductivity increases with progressive precipitation of the excess solute. The changes in microstructure with heat-treatment have also been investigated.—A. R. P.

\*The Systems Tin-Germanium and Tin-Beryllium. W. Guertler and M. Pirani (Tech. Publ. Internat. Tin Res. Develop. Council, Series A, 1937, (50), 23 pp.).-Germanium-tin alloys were prepared by adding germanium to tin melted in unglazed porcelain under sodium chloride. Microscopic investigation of the slowly cooled alloys showed bluish crystals of germanium in a groundmass of tin, which by spectroscopic analysis was found to contain 0.1-0.01% germanium. These results, together with results of thermal analysis, suggest a diagram similar to that of the silicon-tin system. Tinberyllium alloys were prepared by heating a compressed mixture of the powdered metals in a beryllia crucible in pure hydrogen, and it was found that beryllium is only partly soluble in tin in the liquid state. Analysis of the tin layer showed a few tenths of one per cent. of beryllium. Hardness, Erichsen, and bending tests were carried out on an alloy containing 0.35% germanium and on one containing 0.2% beryllium, together with alloys of tin containing small amounts of arsenic, zinc, bismuth, lead, and antimony. Germanium was found to increase the hardness by 100% in the cast and rolled alloys, but beryllium only caused a slight increase. Erichsen values were reduced about 20% by both elements, but while germanium seriously reduced the bending values, beryllium caused a slight increase.-G. J. T.

Properties of the Newer Hard Carbides. Henry R. Power (Metal Cleaning and Finishing, 1937, 9, (1), 61-62).—A brief resume of the properties and uses of the carbides of titanium, zirconium, vanadium, columbium, and tantalum.—A. R. P.

\*Some Properties of the Metallic State. I.-Metallic Hydrogen and Its Alloys. A. R. Ubbelohde (Proc. Roy. Soc., 1937, [A], 159, (897), 295-306).-When hydrogen dissolves in palladium or other transitional metals, it is probably present in the metallic state, i.e. dissolved as atoms, and partly dissociated into protons and electrons. Properties of these alloys of hydrogen are discussed, and are interpreted on the assumption that the s electrons of hydrogen can occupy states of lower energy by filling the vacant states or "holes" in the d band of the transition metal. The effect of lattice spacing on the energy states of a transitional metal is discussed in connection with the existence in equilibrium of two solid solutions with the same structure but different lattice parameters. The hysteresis phenomena in the system palladium-hydrogen are discussed, and are regarded as due to a condition in which the free energy and equation of state cannot be completely expressed in terms of pressure, temperature, and concentration, but may involve additional variables such as the degree of order or mechanical strain, and a modified phase rule is proposed. The abnormal coeffs. of expansion of nickel-iron alloys such as Invar are also dealt with .-- W. H.-R.

Some Properties of the Metallic State. II.—Metallic Hydrogen and Deuterium. A. R. Ubbelohde (*Proc. Roy. Soc.*, 1937, [A], 159, (897), 306– 313).—The lattice spacings and electrical resistances of alloys of palladium with hydrogen and deuterium were investigated. In alloys containing both  $\alpha$  and  $\beta$  phases in equilibrium at 20° C., the lattice expansions are :  $\alpha$ -phase, hydrogen 0.0041  $\pm$  0.0002 A., deuterium 0.0028  $\pm$  0.0003 A.;  $\beta$ -phase, hydrogen 0.1430  $\pm$  0.0004 A., deuterium 0.1325  $\pm$  0.0004 A. The solubility of deuterium in the  $\beta$ -phase is greater than that of hydrogen, and its effect in increasing the resistance of palladium is greater. These results agree with the assumption that metallic deuterium is somewhat less ionized in the alloy than hydrogen, and the theoretical interpretations are discussed. The hysteresis effects for gas-charged palladium + hydrogen described by other authors are discussed, and indicate that the ionization of the dissolved hydrogen does not exceed about 90% at ordinary temperatures.—W. H.-R.

\*The Ageing of Ternary Alloys. G. G. Urasov and T. E. Shushpanova (*Izvestia Akademii Nauk S.S.S.R. (Bull. Acad. Sci. U.R.S.S.)*, 1936, [Chim.], (2), 321-347).--[In Russian, with English summary.] The mechanism of the process in ternary alloys is considered theoretically. Experiments on magnesium-silicon-aluminium alloys show that the best mechanical properties after ageing are obtained with compositions slightly to one side of the Al-Mg<sub>o</sub>Si line.--N. A.

\*The Phase Boundaries in Binary Alloys. I.-The Equilibrium Between Liquid and Solid Phases. II.—The Theory of the  $\alpha$ ,  $\beta$  Phase Boundaries. H. Jones (*Proc. Phys. Soc.*, 1937, 49, (3), 243–249, 250–257).—(I.—) The thermodynamical theory of the melting point and freezing point curves in the  $\alpha$  solid-solution region of binary alloys is briefly discussed mathematically. The van't Hoff relation should be applicable to these alloys, and its validity is established. It is shown, from experimental results, that the change in the latent heat when small quantities of nickel, zinc, gallium, or germanium are dissolved in copper is proportional to the electron : atom ratio. Similar results are obtained for cadmium, indium, or tin dissolved in silver. A qualitative theory accounting for these facts is proposed. (II.---) A quantitative theory of phase boundaries in alloys between the face-centred and body-centred cubic structures is given, and is applied in detail to alloys in which copper is the major constituent. The width of the  $(\alpha + \beta)$  mixedcrystal region is obtained with fair approximation : it is found that this width decreases with increasing valency of the solute element. This is in accord with experimental results. Fair agreement is found between theoretical and experimental values of the variation with temperature of the limits of the  $\alpha$  and  $\beta$  regions.—J. S. G. T.

\*The Quantum Theory of the Electrical Conductivity of Alloys in the Superlattice State.—II. Toshinosuke Muto (Sci. Papers Inst. Phys. Chem. Res. (Tokyo), 1937, 31, (683), 153-160).—Cf. Met. Abs., this vol., p. 42. The reflection of X-rays from alloys with completely or partly ordered structures is investigated theoretically. A method is deduced for determining the long distance order S, from the relative intensities of reflected X-rays, and is applied to the Debye-Scherrer diffraction data given by Ageew and Shoyket (Met. Abs., 1935, 2, 467) for copper-gold alloys of the Cu<sub>3</sub>Au type. For annealed alloys containing 22-68, 24-90, and 29-49 atomic-% of gold, the calculated values of S are 0.77, 0.82, and 0.59, respectively, and are thus reasonable. A more detailed comparison of the effect of composition on the relative intensities of the 213 and 004 reflections shows a qualitative agreement between experiment and theory.—W. H.-R.

\*The Laws of Phase Changes in Eutectoid Alloys. G. Kurdjumow (Izvestia Akademii Nauk S.S.S.R. (Bull. Acad. Sci. U.R.S.S.), 1936, [Chim.], (2), 271-284).—[In Russian, with English summary.] The processes which take place in undercooled solid solution alloys are discussed and the influence of temperature on transformation rates is examined. Two different processes are possible, viz. those due to diffusion and those occurring spontaneously without diffusion. The latter were studied in copper-aluminium, coppertin, and copper-zinc alloys. Both types occur together in an alloy .- N. A.

\*Physicochemical Investigation of Intermetallic Molecular Solid Solutions. N. Ageew (Izvestia Akademii Nauk S.S.S.R. (Bull. Acad. Sci. U.R.S.S.), 1936, [Chim.], (2), 285-319).-[In Russian, with French summary.] Investigations of the crystal structure and of the nature of phases of variable composition in the systems : gold-copper, lead-sodium, thallium-bismuth, silveraluminium, iron-silicon, iron-antimony, iron-aluminium, and coppermanganese-aluminium show that these phases may be regarded as molecular solid solutions of intermetallic compounds. If the composition of the comsolution is beyond the homogeneity limit of the phase, the compound may be called "imaginary" and the phase a "berthollide." Compounds in dilute solid solutions are probably completely dissociated .-- N. A.

#### III.—STRUCTURE

## (Metallography; Macrography; Crystal Structure.)

#### (Continued from pp. 187-191.)

A Note on the Mounting of Specimens in Bakelite. J. L. Everhart (Metals and Alloys, 1937, 8, (4), 115).-The specimen is covered with Bakelite varnish S.D. 17, dried at 45° C. for 10-15 minutes and then embedded in a mixture of 80-90% of Bakelite resin R. 3220 and 20-10% of hardener X.K. 2997 in a mounting cup. After heating for  $\frac{1}{2}$  hr. at 40°-65° C. and  $1\frac{1}{2}$ -2 hrs. at 65°-70° C. the specimen may be cut and polished in the usual way.-A. R. P.

\*The Recrystallization of Aluminium-Magnesium Alloys. R. Michaud and E. Segol (Compt. rend., 1937, 204, (12), 980-983) .- Increasing the temperature after quenching aluminium-magnesium alloys of low magnesium content has two effects : precipitation of the \$-phase, and recrystallization of the grains. Two sets of experiments were carried out on a series of alloys containing 2.13-12.70% magnesium to determine whether recrystallization may only begin when precipitation is almost complete: (1) The beginning of recrystallization was determined by Laue diagrams taken after tempering for 4-hr. at temperatures increasing by 10° C. The resulting curve consisted of : (a) a descending branch up to 3% magnesium, the lowering of the temperature of initial recrystallization being due solely to the known effects of cold-working, and (b) an ascending branch above 4% magnesium, the effect of precipitation being greater than that of cold-working, and the temperature of initial recrystallization increasing with the magnesium content. (2) Measurements of the reticular distances by Debye-Scherrer diagrams on the plane [422] showed : (a) that for alloys quenched but not tempered the variation of the reticular distance is linear, and (b) that for alloys tempered up to initial recrystallization a curve is obtained which, in comparison with curve (a) enables the percentage of magnesium remaining in solution to be determined. It is found that this is precisely that indicated by the solubility curve at the temperature considered; the precipitation of the particles is thus reasonably complete at the beginning of recrystallization. These results then confirm the hypothesis, showing that the retarding effect of the  $\beta$ -phase on the increase in grain-size of the quenched alloys persists so long as this phase is not entirely precipitated.

-J. H. W.

\*On Nuclei Formation During Recrystallization. IV .- The Orientation of Recrystallization Nuclei. M. Kornfeld (Physikal. Z. Sowjetunion, 1937, 11, (3), 297-301).-[In German.] Cf. Met. Abs., 1936, 3, 118; this vol., p. 45, and following abstract. The relation between the recrystallization texture of hard-drawn aluminium wire and the texture of the original plasticallystrained material is investigated experimentally and discussed briefly .-- J. T. \*On Nuclei Formation During Recrystallization. V.—Effect of Relaxation

on the Velocity of Nuclei Formation During Subsequent Recrystallization. M. Kornfeld and A. Schamarin (*Physikal. Z. Sowjetunion*, 1937, **11**, (3), 302– 306).—[In German.] Cf. preceding abstract. The effect of relaxation on the rate of nuclei formation during subsequent recrystallization in the case of plastically-deformed single crystals of aluminium is found to be very different from that previously found for polycrystalline aluminium (cf. *Physikal. Z. Sowjetunion*, 1934, **6**, 537). The apparent contradiction between the two processes is removed by the assumption of a lack of uniformity in the effect of relaxation in various regions of the deformed materials. In some regions the incubation-period for the formation of recrystallization nuclei is increased, in others decreased, owing to structural differences characterizing the singleand polycrystalline materials.—J. S. G. T.

\*The Structure of Polished Metal Surfaces. S. Dobinski (*Phil. Mag.*, 1937, [vii], 23, (154), 397-408).—The conflicting results obtained by the method of electron diffraction for the structure of polished metal surfaces are discussed critically. New experiments are described in which 10 different metals were polished under benzene, and placed while still wet in the camera, which was immediately evacuated so that exposure to air was reduced to a minimum. These surfaces gave electron diffraction patterns consisting of the well-known diffuse haloes, but, in contrast to previous work, the size of the haloes was not uniform, but varied from one metal to another. The results agreed with an amorphous surface layer with a close-packed ensemble of atoms in thermal agitation. The closest distances of approach in this amorphous layer are equal to those in the crystalline structure of the elements concerned. Surfaces polished in air are heavily oxidized, and the oxide layer is responsible for some of the conflicting results previously obtained.—W. H.-R.

**Optical Research of Thin Layers.** L. S. Ornstein and P. J. Haringhuizen (*1st Internat. Electrodeposition Conf. (London), Advance Copy*, **1937, 4** pp.).— Optical measurements on thin films of copper electrolytically deposited on thin platinum films sputtered and burned on to glass were made after corrosion in heated transformer oil and in cold olive oil; the results show that the magnitude of corrosion is of the same order as that of sputtered films of copper on glass, hence evaporated layers of metal may be used to study the action of corroding media on the metal.—A. R. P.

\*Structural Changes During the Growth of Metal Films. A. G. Quarrell (Proc. Phys. Soc., 1937, 49, (3), 279-293).—Electron-diffraction patterns of thin films of face-centred cubic crystals of metals prepared by evaporation, electrodeposition, chemical deposition, and chemical displacement often show extra rings and bands which may be regarded as typical of the face-centred cubic structure rather than of the metal itself. It is shown that these extra rings are due to the fact that the first deposited layers crystallize in closepacked hexagonal crystals having an axial ratio c/a = 1.63, the effective atomic radius being the same as in the normal face-centred cubic form. A gradual transition from close-packed hexagonal to face-centred cubic is postulated, and the prominent band is attributed to a progressive contraction of the (100) hexagonal spacing to the (200) cubic spacing during the transition. Some very thin evaporated films showed structures intermediate between the hexagonal and cubic modifications; it is concluded that the transition occurs gradually as deposition proceeds, and is not due to an atomic rearrangement occurring when a certain critical film-thickness is reached. These views are supported by the discovery of: (1) an electrodeposited silver film composed solely of close-packed hexagonal crystals; (2) a similar gold specimen giving a pattern in which hexagonal and cubic diffraction are equally marked, and (3) evaporated cobalt films consisting mainly of the former together with some of the latter form .--- J. S. G. T.

\*The Crystal Structure of Copper Electrodeposits .-- I. Arthur Phillips and

Walter R. Meyer (1st Internat. Electrodeposition Conf. (London), Advance Copy, 1937, 6 pp.; and Met. Ind. (Lond.), 1937, 50, (19), 539-541.)—The limiting current density for the formation of columnar crystals of copper from an acid sulphate electrolyte is 1 amp./dm.<sup>2</sup>; deposits made at more than 2·2 amp./dm.<sup>2</sup> no longer reproduce the structure of the basis metal. From cyanide electrolytes the crystal structure of the deposit does not follow that of the basis metal at above 0·1 amp./dm.<sup>2</sup>, but at a lower current density a regular structure oriented normal to the cathode surface is obtained. Zine has only a small effect on the structure of copper deposits when co-deposited, but lead has a pronounced grain-refining and brightening effect when present to the extent of 0·01 and 0·1 grm./litre if the current density used does not exceed 0·1 amp./dm.<sup>2</sup>.—A. R. P.

\*Diffraction of Electrons by Silver and Gold Films Formed by Cathodic Deposition on Crystalline Substrates. A. Bojinescu (Bull. Soc. Roumaine Phys., 1936, 37, (67), 3-18; Sci. Abs., 1937, [A], 40, 318) .--- [In German.] A diffraction camera is designed for use with a hot or cold cathode, and a multiple diaphragm system, without electromagnetic focussing, is employed. The specimen carrier is of the simplest form and no adjustments are possible. A motor-driven electrostatic machine is used as the h.v. source (50 kv.) and with discharge currents of the order of 0.2 ma. and a camera length of 13.5 cm. the exposure times are 1-5 seconds. In the work described, gold and silver films are sputtered on the faces of soluble crystals at room temperature, and subsequently stripped for use as transmission specimens. It is shown that, when deposited on rock-salt, gold and silver films gradually change from small random crystals to a single crystal in cube face orientation as the film thickness, determined by Fery's method, is increased from 15 to 95 mu. No such effect is observed with sodium nitrate, potassium iodide, copper sulphate, alum, or tartaric acid substrates, as even thick metal films are polycrystalline. It is suggested that the temperature of deposition does not fall within the range of the electric Curie points of these substrates, which therefore have little influence on the deposited metal.-S. G.

The Form of a Spot in Electron Diffraction Pattern(s). V. A. Kolpinsky (*Physikal. Z. Sowjetunion*, 1937, 11, (3), 356-358).—[In English.] A theory of the forms of spots obtained in electron diffraction patterns is briefly developed and illustrated by examples of spots obtained by Cochrane (*Met. Abs.*, 1936, 3, 396).—J. S. G. T.

\*Distortion of [Metal] Grains by Fatigue and Static Stressing. Charles S. Barrett (Metals and Alloys, 1937, 8, (1), 13-21; and (summary) Metallurgia, 1937, 15, (89), 165).—From X-ray photograms of specimens of aluminium, steel, and Armco iron taken during fatigue tests by a camera in which the specimen and the film are synchronously oscillated, evidence has been obtained in support of the theory that considerable plastic flow can occur by fatigue stressing in the safe range below the endurance limit. The photograms show that the lattice of a polycrystalline metal is progressively distorted into wider ranges of orientation when subjected to increasing elongation in tension or increasing stress amplitude in fatigue, and that the diffraction lines simultaneously become wider.—A. R. P.

\*An X-Ray Study of Preferred Orientation in Rolled Copper. H. V. Anderson and G. L. Kehl (*Metals and Alloys*, 1937, 8, (3), 73-76; and (summary) *Met. Ind.* (*Lond.*), 1937, 50, (23), 628).—The amount of preferred orientation on the surface of cold-rolled copper is not influenced by the method of rolling (whether direct or reverse rolling after each pass) provided that the degree of reduction is the same. At a distance of 0-0004 in. below the surface, however, reverse rolling produces a more random orientation than does direct rolling. The severity of the rolling to the same total reduction does not influence the degree of surface or interior preferred orientation.—A. R. P. \*The Energy of the Superlattice in  $\beta$  Brass. N. F. Mott (*Proc. Phys. Soc.*, 1937, 49, (3), 258-262; discussion, 263).—The body-centred alloy  $\beta$ -brass (CuZn) forms a superlattice below about 460° C. An estimate of the energy required to destroy the superlattice, and hence of the heat absorbed in the transition from the ordered to the disordered state is derived. The total energy of the superlattice per atom is found to be 0.040 e.v.—J. S. G. T.

The Crystal Structure of Mn<sub>5</sub>Si<sub>3</sub>. Karin Åmark, B. Borén, and A. Westgren (*Svensk Kem. Tid.*, 1936, 48, 273–276).—[In English.] The formula Mn<sub>5</sub>Si<sub>3</sub> (Vogel and Bedarff, *Met. Abs.*, 1934, 1, 295) is confirmed.—S. G.

\*The Preferred Orientation Produced in Pure Iron-Nickel Allovs by Cold-Rolling. D. McLachlan, Jr., and Wheeler P. Davey (Phys. Rev., 1937, [ii], 51, (1), 60).—Abstract of a paper read before the American Physical Society. Ribbons whose total impurities did not exceed 40 parts per million were coldrolled in a single direction at a speed of about 6 in./minute. Underneath a surface skin 1 mil thick, the degree of orientation depends only on the percentage total reduction; it is independent of the reduction per pass and of the nickel content up to 22% nickel. By using a quantitative concept for a unit pole, the degree of preferment of orientation is expressed in terms of pole density on a sphere of reference. Three assumptions are made as to the mechanism of rolling. These enable orientations to be expressed by two parameters instead of three. A simple probability function has been found for the chance that a crystal fragment will have a given orientation. Pole densities from this probability function agree with those found by experiment. The theoretical equation requires a knowledge from experiment of only the ratio of two numbers which express the maximum deviation of orientation from the optimum along each of two co-ordinates used in plotting the results. -S. G.

\*The Lattice Spacing of Iron-Nickel Alloys. A. J. Bradley, A. H. Jay, and A. Taylor (Phil. Mag., 1937, [vii], 23, (155), 545-557).—The lattice spacings of 35 iron-nickel alloys, slowly cooled to room temperature, were determined. For the iron-rich body-centred cubic alloys the lattice spacings increase from 2.8605 A. for pure iron to 2.8644 A. for 5.7 atomic-% of nickel. For alloys in the two-phase region the lattice spacing is 2.8635 A. corresponding with 4.4 atomic-% nickel, and this value should be taken as the true phase boundary ; it is not known why the 5.7 atomic-% alloy remains as a single phase on slow cooling. The lattice spacings of the face-centred cubic nickel-rich alloys increase from 3.5169 A. for pure nickel to a maximum of 3.5878 A. at 38.69 atomic-% of nickel, and then decrease to 3.5741 A. at 28 atomic-% of nickel, which is the position of the phase boundary after slow cooling. The spacing changes linearly with the composition from 100 to 78% nickel by weight, and again linearly to 45% nickel; the break at 78% nickel corresponds with the composition of the high-permeability alloy Permalloy. The face-centred cubic alloys were examined after quenching from different temperatures, and anomalous results were obtained which may be connected with the magnetic changes .--- W. H.-R.

\*An X-Ray Analysis of the Nickel-Aluminium System. A. J. Bradley and A. Taylor (*Proc. Roy. Soc.*, 1937, [A], **159**, (896), 56-72).—An X-ray examination of the nickel-aluminium system was made from powder photographs of slowly cooled and quenched alloys. The  $\alpha$ -phase is a face-centred cubic solid solution of aluminium in nickel, and extends to 20-27 atomic-% of aluminium at high temperatures; at low temperatures it gives rise to the  $\alpha'$  phase which is a face-centred cubic solid solution with a superlattice structure, based on the composition Ni<sub>3</sub>Al, with nickel atoms occupying the centres of cube faces, and aluminium atoms the cube corners. At high temperatures the  $\alpha$  and  $\alpha'$ phase regions join together, but below about 1000° C. there is a miscibility gap, and alloys exist with the ordered and disordered structures in equilibrium. The  $\beta$ -phase is based on NiAl with the casium chloride type of body-centred

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cubic structure. The lattice spacing reaches a maximum at the composition NiAl. With excess of nickel, the spacing decreases, the large light aluminium atoms being replaced by small heavy nickel atoms. With excess of aluminium, the lattice spacing decreases rapidly. This unexpected result is due to a peculiar type of solid solution in which, instead of one kind of atom replacing another, the change in composition is effected by the nickel atoms dropping out, and leaving empty spaces in the lattice. The lattice spacing and density decrease simultaneously until ultimately the structure changes to the  $\delta$  phase Ni<sub>2</sub>Al<sub>3</sub> after a narrow two-phase region at about 63 weight-% nickel. The  $\delta$  phase extends from 37.3 to 41.35 atomic-% nickel after slow cooling; its structure is closely related to that of NiAl, one-third of the aluminium atoms having been lost with the production of a deformation which makes the structure trigonal instead of cubic. The  $\varepsilon$  phase NiAl<sub>3</sub> has an orthorhombic elsewhere.—W. H.-R.

\*Intensities of X-Ray Reflections from Single Crystals of Sodium Between 120° and 370° K. Ralph H. V. M. Dawton (*Proc. Phys. Soc.*, 1937, 49, (3), 294-305; discussion, 305-306).—When a small piece of sodium is crystallized from a melt, it is found, on the average, to give a lower reflecting power for X-rays than would be expected if it crystallized in the ideally imperfect state. The crystals, subjected to a cycle of heating and cooling, show marked hysteresis, which vanishes when the crystals are chilled with liquid air. The characteristic temperature, calculated by the Debye–Waller formula, is found to be 130°  $\rightarrow$  141° K. for the range 0°  $\rightarrow$  120° K.—J. S. G. T.

\*The Atomic Vibrations of Zinc Crystals at Liquid Air Temperature. G. E. M. Jauncey and W. A. Bruce (*Phys. Rev.*, 1937, [ii], **51**, (1), 60).—Abstract of a paper read before the American Physical Society; see also *Met. Abs.*, 1936, **3**, 458.—S. G.

\*Structure of Compounds of the Rare Earths with the Metalloids of Group V. A. Iandelli and E. Botti (Atti R. Accad. Lincei (Roma), 1936, 24, 459-464; Sci. Abs., 1937, [A], 40, 344) .- The method and difficulties of preparing the phosphides of lanthanum, cerium, and praseodymium are described. The structures are studied by the X-ray powder method. All the lines on the photographs can be indexed by means of Hull's graphs for a face-centred cubic lattice. There are two possible structures; either a lattice of the zinc blende type or one of the sodium chloride type. As other phosphides are known to have a blende type of lattice, it is concluded that this is the most probable. The cell sides have dimensions 6.01, 5.89, and 5.86 A. for the lanthanum, cerium, and praseodymium compounds, respectively. Arguments in favour of a possible ionic structure of these phosphides are: the characteristic lattice of ionic compounds, and the fact that if the size of the elementary cell is calculated from the atomic radii of the metals and of phosphorus the value is always lower than the experimental value. The value of the atomic radius of  $\vec{P}^{3-}$  obtained from the experimental results is 1.77 A. compared with Pauling's value of 2.12 A.—S. G.

On the Radial Texture in the Surface Layer of Cylindrical Metal Bodies. V. I. Arharov (Zhurnal Tehnicheskoy Fiziki (J. Tech. Physics), 1936, 6, (10), 1747-1770).—[In Russian.] The appearance of a texture radiogram was established theoretically in the case of a specimen opaque to X-rays. Expressions are given for calculating the textures. The hardest possible X-rays should be used to establish this texture. Commercial metals may be considered as practically opaque. Expressions are given for a real radial texture, in which the imperfection of the crystal orientation is characterized by an angle.—N. A.

## IV.-CORROSION

#### (Continued from pp. 191-194.)

\*The Effect of Additions of Antimony on the Corrosion of Cast Aluminium. M. P. Slavinskiy and N. T. Blinova (*Metallurg* (*Metallurgist*), 1936, (12), 95–101).—[In Russian.] Addition of small amounts of antimony to aluminium increases the resistance to corrosion by sea-water owing to the formation of a protective oxide film containing antimony. Alloys of the type of K.S.-Seewasser, containing magnesium, manganese, and antimony are suitable for clad coatings which must have high mechanical properties, pressure-tightness, and corrosion-resistance; 0.1-0.2% of antimony is sufficient.—N. A.

\*Corrodibility of Aluminium Alloys.—I. Hideo Nishimura (Suiyokwai-Shi (Trans. Min. Met. Alumni Assoc.), 1937, 9, (3), 141–152).—[In Japanese.] The corrosion of aluminium alloys in sodium chloride or dilute hydrochloric acid solution was studied by measurements of change of weight or gas evolution. The corrosion of aluminium alloys containing magnesium as principal constituent is decreased by the addition of about 0.5% manganese to the order of that of industrial pure aluminium; antimony and zine do not improve the corrosion-resistance. Alloys containing about 1.5% manganese and 0.3%chromium, however, are more resistant to corrosion by these agents than is pure aluminium.—S. G.

\*A Study of the Amount and Conditions for the Solution of Copper from Apparatus and Vessels During the Preparation of Fruit and Berry Products. A. M. Kogan and K. M. Nasyrova (Voprosy Pitaniya (Problems of Nutrition), 1936, 5, (5), 61-72; C. Abs., 1937, 31, 2697).--[In Russian.] During boiling in a vacuum apparatus, from 2.7 to 22 mg. of copper per kg. of fruit are dissolved, and in the grinding machine from 7 to 186 mg. Marmalades dissolve 2-15 mg. and gooseberries on prolonged boiling 33 mg. Previous to use, copper vessels should be thoroughly washed, but not scraped, and then thoroughly dried.--S. G.

Action of Water on Lead. — (Rep. Water Pollution Research Board, 1936, 1937, 6-7, 14-16; Bull. B.N.F.M.R.A., 1937, (97)).—The Water Pollution Research Board has continued investigations in two directions: (a) development of a method for studying the action of water on lead; and (b) a method for determining the concentration of lead in household water (a metered quantity of water is drawn through powdered magnesia; this takes out all the lead, which can be estimated by a simple method. Four tests on a moderately hard household water showed average concentrations of lead ranging from 0.05 to 0.10 p.p.m.).—S. G.

\*Corrosion of Lead-Sodium Alloys. A. B. Schachkeldian and M. N. Ambroji (Abh. Staatsuniv. Saratov, 1936, 1, 73-82; Brit. Chem. Abs., 1937, [B], 145). —The loss of weight of anodes from two lead-sodium alloys during electrolysis of aqueous sulphuric acid, sodium acetate, sodium chloride, sodium sulphate, sodium nitrate, ammonium sulphate, and their mixtures was measured. In some solutions it is less than the loss of weight of a lead-antimony anode as used in accumulators.—S. G.

\*Corrosion of Elektron Alloys. Hachie Sawamoto (Suiyokwai-Shi (Trans. Min. Met. Alumni Assoc.), 1937, 9, (3), 179-188).—[In Japanese.] A comparison was made of the rates of corrosion of cast and heat-treated Elektron alloys in dilute acid and aqueous sodium chloride solutions by measurements of the gases evolved. The heat-treated specimens were heated at 400° C. for 64 hrs. and quenched in water at 15° C.; they were then tempered at 100°, 150°, and 200° C. for 2 hrs. From the corrosion experiments it is concluded that the heat-treated alloys are more resistant than the cast ones, and that the addition of zine to the alloys improves the corrosion-resistance.—S. G.

\*A Quality Index for the Corrosion-Resistance of Tinplate. G. Gire (*Rev. Trav. Office Péches Maritimes*, 1936, 9, (4), 421-436; *Bull. B.N.F.M.R.A.*, 1937, (96)).—G. measures the amount of tin and iron dissolved from tinplate specimens by dilute acetic acid in 10 days and proposes the ratio of these two quantities as an index of the corrosion-resistance of the tinplate. Tests were carried out on 23 samples and the results compared with the ferricyanide and G.'s sulphide test (see *Met. Abs.*, 1936, 3, 546). The results are interpreted with respect to actual and "potential" pores.—S. G.

The Problem of the Transfer of Lead from the Tinning into Food Products. A. M. Kogan and S. L. Rokhlina (Voprosy Pitaniya (Problems of Nutrition), 1936, 5, (5), 53-60; C. Abs., 1937, 31, 2693).—[In Russian.] When the tinning contains less than 0.45% lead, lead is not dissolved when potatocs, onions, or carrots are cooked. At 1% lead slight amounts are dissolved, especially by sour cabbage (sauerkraut).—S. G.

\*The Decrease of Corrosion During the Removal of Incrustations with Hydrochloric Acid. I.-Experiments with Pure Materials. J. Forman (Listy Cukrovar, 1936, 55, 121-125; C. Abs., 1937, 31, 2571) .-- Iron and brass sheets,  $4 \times 4$  cm. square, were immersed in 100 c.c. of 1, 5, and 10% hydrochloric acid containing 0, 1, or 10 grm. of an inorganic agent or 0.0, 0.02, 0.1, 0.5 or 1.0 grm. of an organic agent. After 4 and 16 hrs. of action at 20° C. the plates were dried and weighed. The presence of calcium chloride, ammonium chloride, ammonium sulphate, ferrous sulphate, and potassium ferrocyanide hastened the corrosion of iron. Oxidizing agents (potassium nitrate, potassium dichromate, chloramine) increased the corroding action of hydrochloric acid on iron. Organic agents (formaldehyde, aniline, pyridine, quinoline, o-, m- and p-toluidine, xylidine, phenol, and triamylamine) decreased the corrosion of iron; triamylamine was the best inhibiting agent-it retarded the action by 87%. The action of calcium chloride was somewhat retarded by the presence of sucrose. Corrosion of brass plates showed the same tendencies of the reagents, although they were less marked. The following series is unique: the corrosion in free hydrochloric acid was 60 mg., the presence of quinoline increased the corrosion to 90 mg.; p-toluidine decreased it slightly (55 mg.); o-toluidine decreased it to 45 mg., and m-toluidine decreased it to 40 mg.-S. G.

\*The Corrosion of Alloys. Henri Triché (Compt. rend., 1937., 204, (12) 966–968).—The mechanism of the analysis of extremely thin metallic films by means of the high frequency spark (see Met. Abs., 1936, 3, 84) is as follows : consider a binary alloy of two phases, A and B, not covered by an insulating film. If the surface has no roughness due to the constituents themselves, and  $C_1$  is the concentration of the metal in A and  $C_2$  that in B,  $S_1$  and  $S_2$  are the surfaces of A and B, respectively, and  $e_A$  and  $e_B$  the thicknesses removed by each spark and supposedly small compared with the crystal dimensions, the surface concentration,  $C = C_1 S_1 e_A + C_2 S_2 e_B$ . If the constituent A is dissolved by suitable treatment, roughness of the surface is produced, the surface of B being considerably increased. If the roughness is small compared with the spark, the mechanism will be as above; if large, the surface concentration will be equal to that of B. This method has been applied to the study of corrosion. The surface of a simple cadmium-bismuth alloy, which consists merely of the two phases of the pure metals, was attacked by dilute sulphuric acid. On comparing the spectra of the untreated and treated surfaces, a considerable increase in the bismuth lines was observed. In more complex alloys, secondary reactions may mask the initial phenomenon. This method enables the action of certain reagents on light alloys to be studied. For example, the action of sulphuric acid on 8% copper-aluminium enriches the surface in copper, whilst concentrated nitric acid causes a very slight enrichment of aluminium. It also enables the distribution of impurities to be detected, as, for instance, in the cadmiun-bismuth alloy, an unexpected increase in calcium lines with the bismuth lines was observed.—J. H. W.

The Chemical Stability Towards Moist Sulphur Dioxide of Metals and Alloys of Soviet Manufacture. I. Ya. Klinov and V. V. Andreeva (Zhurnal Khimicheskoi Promishlennosti (J. Chem. Ind.), 1936, 13, 1474–1477; C. Abs., 1937, 31, 2142).—[In Russian.] Cf. Met. Abs., 1936, 3, 542. Chromium-nickel and chromium-nickel-manganese steels are resistant to the action of moist sulphur dioxide. Addition of titanium and molybdenum reduces the resistance. Other metals are unsuitable under these conditions.—S. G.

Influence of Organic Compounds on the Corrosion of Metals by Inorganic Agents. V. K. Pershke and A. S. Vinogradova (*Promishlennost Organicheskot Khimii* (Org. Chem. Ind.), 1936, 2, 419-423; C. Abs., 1937, 31, 1750).—[In Russian.] A physico-chemical interpretation of the inhibiting action of stable organic compounds and accelerating action of easily reducible organic compounds on the destruction of metals by corroding agents in the process of PhNH<sub>2</sub> production, based on the literature and some experimental data (cf. Jenekel and Bräucker, Z. anorg. Chem., 1935, 221, 249; Jimeno and Griffol, Mct. Abs., 1936, 3, 276).—S. G.

\*A Study of Oxide Films on Metal Surface(s) with Cathode Ray Diffraction. II.—Fe, Cr, Ni, and Their Alloys. Shizuo Miyake (Sci. Papers Inst. Phys. Chem. Res. (Tokyo), 1937, 31, (684), 161–173).—Cf. *ibid.*, 1936, 29, 167. Electron diffraction methods have been used to study the surface films formed by heating metals and alloys in (a) an electric furnace, and (b) the flame of a gas burner. When commercial iron is heated above 250° C. the outermost layer of the film consists of  $\alpha$ -Fe<sub>2</sub>O<sub>3</sub> below which is a layer of Fe<sub>3</sub>O<sub>4</sub>, but at lower temperatures only Fe<sub>3</sub>O<sub>4</sub> is formed. Nickel and chromium give rise to NiO and Cr<sub>2</sub>O<sub>3</sub>, respectively, whilst Nichrome containing 20% of chromium gave a film of pure NiCr<sub>2</sub>O<sub>4</sub>. With copper-nickel alloys of different compositions the method revealed only CuO in the black surface film, but when this film was removed from an alloy containing 7% of nickel, a brown film of NiO was revealed, and it is possible that the increased resistance to oxidation with increasing nickel content is due to a thin layer of NiO underlying that of copper oxide. With iron-aluminium and iron-nickel alloys, only  $\alpha$ -Fe<sub>2</sub>O<sub>4</sub> was detected. Chrome steel and nickel chrome steel were also examined and gave complex results.—W. H.-R.

Corrosion Problems. Geo. M. Enos (Products Finishing, 1937, 1, (5), 10–12, 14–16).—A review, dealing with the mechanism and rate of corrosion.
 Best Tests for Corrosion and Electroplates. William Blum (Metal Progress,

Best Tests for Corrosion and Electroplates. William Blum (Metal Progress, 1937, 31, (4), 386–388).—Brief reviews of 6 papers on the principles and practice of corrosion testing, read before the Amer. Soc. Test. Mat. The review includes a brief note on the present position of the exposure tests on plated coatings now in progress under the auspices of the Amer. Electroplaters' Soc., etc.—P. M. C. R.

## **V.**—**PROTECTION**

#### (Continued from pp. 194-196.)

Structural Precautions to Avoid Corrosion in Chemical Apparatus. P. Schafmeister and H. Braun (Korrosion VI, 1937, 24-29; discussion, 29-30).— Stress is laid on the necessity for avoiding contact between two dissimilar metals, need for constructing the apparatus in such a way that there are no narrow channels in which stagnant liquor or corrosion products may collect, for using metals with a good surface to prevent local pitting and electrolytic action, and for designing the heating unit in such a way that no local overheating can occur.—A. R. P.

The Anodic Oxidation of Aluminium. Maurice Déribéré (*Pratique Indust.* mécan., 1937, 20, (1), 21-24).—A review of the applications of anodically oxidized pieces. A tabulated summary is given of the plant, type of current, voltage, electrolytes, bath temperature, characteristics of surface, and methods of finishing usual in the Bengough, Eloxal, and Alumilite processes.—P. R.

Principles, Present Position, and Examples of Surface Treatment of Light Metals and Light Metal Alloys. Heinrich Carlsohn (*Metallwaren-Ind. u. Galvano-Tech.*, 1937, 35, (1), 16, 18, 20).—A brief review of immersion and electrolytic oxidation processes.—A. R. P.

The Surface Treatment of Magnesium Alloys. H. Reininger (Metallwaren-Ind. u. Galvano-Tech., 1937, 35, (2), 41-42; (3), 63-66; (4), 99-101, 103).— A review of the patent and journal literature.—A. R. P.

\*The Tinning of Steel Strip by Electrodeposition. I.—Electrodeposition and Polishing of Thin Coatings of Tin on Steel. (Macnaughtan, Tait, and Baier.) II.—The Effect of Deformation on the Protective Value of Hot-Dipped and Electrodeposited Tin Coatings. (Macnaughtan and Prytherch.) See p. 249.

The Wholesomeness of Canned Foods. H. B. Cronshaw (Information Circ. Internat. Tin Res. Develop. Council, 1937, (2), 16 pp.).—The history and principles and practice of canning are briefly described, and the high quality of canned foods is stressed.—W. D. J.

\*Chemical Studies on Canned Meats. II.—On the Contents of Gases and Metals in Stored Cans. Yuzuru Okuda and Kitaro Katai (Bull. Chem. Soc. Japan, 1936, 11, (11), 715-717).—[In English.] The condition and analysis of several samples of canned meat, crab, and salmon and tunny of various ages are reported.—W. D. J.

Tinplate and Conserves in France. —— (Bull. Internat. Tin Res. Develop. Council, 1937, (5), 94 pp.).—An account is given of various methods employed for combatting chemical, physical, and biological changes in foodstuffs, methods of canning, and nutritive value of canned foods, with particular reference to condensed milks. The food regulations of France as applied to canned foods are discussed, and a very brief description is given of the manufacture of tinplate and can containers, together with a list of commodities canned and some production statistics.—W. D. J.

A Review of the Progress Made in the Field of Hot-Dip Galvanizing. Wallace G. Imhoff (*Amer. Metal Market*, 1937, 44, (78), 3, 6).—Improvements introduced in 1936 into the pickling process, the production of bright finishes, the control of immersion time, and the furnaces and other apparatus used in galvanizing are briefly described.—A. R. P.

Hot-Dip Galvanizing Industry Makes Strides in 1936. Wallace G. Imhoff (Metal Cleaning and Finishing, 1937, 9, (1), 19-20).—Advances in the use of aluminium in galvanizing baths, the removal of scale from covered welding rods, galvanizing furnaces, automatic temperature control, and control of submersion time are briefly discussed.—A. R. P.

Standard Specifications for the Use of Aluminium in Hot-Dip Galvanizing Baths. Wallace G. Imhoff (*Amer. Metal Market*, 1936, 43, (251), 3, 5).— When the zinc contains neither tin nor cadmium, not more than 0.005%aluminium should be added, but 0.01% may be added when small amounts of tin and cadmium are present. For galvanizing pipe, the aluminium content of the bath should be 0.005% with up to 0.25% tin, 0.1% with 0.25-0.5% tin, and 0.03% with 0.5-1.5% tin. Excess of tin should be avoided, as not only does it increase the cost of galvanizing but it tends to produce yellowing of the coating.—A. R. P. The Cementation of Copper Wires. A. Wogrinz (Metallwaren-Ind. u. Galvano-Tech., 1936, 34, (22), 432-434).—Apparatus for treating copper wire with zinc vapour to produce a brass surface with a gold-like appearance is described. Similar results may be obtained by plating the wire with zinc and heating it at above the diffusion temperature in a non-oxidizing atmosphere. The economics of these two processes are discussed.—A. R. P.

\*Metallic Cementation. XI.-Cementation of Molybdenum on Some Metals [Nickel and Iron]. Tsutomu Kase (Kinzoku no Kenkyu (J. Study Metals), 1937, 14, (2), 75-86).-[In Japanese.] The cementation of iron and nickel by molybdenum was studied at various temperatures between 800° and 1300° C. for 1-5 hrs., using powdered ferro-molybdenum containing molybdenum 74.68, carbon 0.11%, and iron remainder. Measurements of the depth of penetration, microscopic examination, chemical analyses, and tests of corrosion by some acids were carried out on the surface layer of the cemented specimens. It was found that : the addition of ammonium chloride to the diffusion mixture gave a negative effect for the diffusion of molybdenum on iron; within the scope of the experiments, below the temperature of the A3 point of iron, molybdenum does not diffuse into iron to a perceptible degree, but above that temperature the diffusion is clearly recognizable and becomes quite remarkable as the temperature increases to 1300° C. Molybdenum diffuses on nickel at a temperature lower than 800° C., and the rate of diffusion increases with increase in temperature. The relation between the increase of weight of the specimen or the depth of penetration and the absolute temperature of cementation or the time required is given by an exponential function. The cemented surfaces are harder than the original material. Although nickel cemented with molybdenum has a sturdy resistance to hydrochloric acid, there is otherwise little advantage as regards corrosion-resistance.-S. G.

Hard-Facing by the Oxy-Acetylene Process. — (Internat. Acet. Assoc., 1936, pp. 41).—Deals with the hard-facing of steels and cast-iron. Monel metal is said to be treated with ease, and brass, bronze, and copper with difficulty. Hard-facing materials are divided into 5 groups: (1) steels with less than 20% alloying elements; (2) steels with over 20% alloying elements; (3) non-ferrous alloys of cobalt, chromium, and tungsten; (4) tungsten carbide in massive form; and (5) crushed tungsten carbide. The characteristics of each group, factors influencing selection, the technique of application, and typical examples in many industries are discussed. Hardness tests are briefly described in an appendix.—H. W. G. H.

Protection from Corrosion by Suitable Surface Treatment. Hermann Kallenbach (*Metallwaren-Ind. u. Galvano-Tech.*, 1936, 34, (22), 429–432).— Various types of apparatus for lacquering and drying metals are illustrated and briefly described.—A. R. P.

#### VI.--ELECTRODEPOSITION

#### (Continued from pp. 196-199.)

\*Cadmium as an Auxiliary Plating. E. E. Halls (*Metal Treatment*, 1937, 3, (1), 27-33).—Results are tabulated of outside exposure (up to 14 days), salt-spray (up to 21 days), and hot and cold humidity cycle (up to 200 days) tests on steel shafts and other components finished with electrodeposits of zinc, copper-nickel, cadmium-nickel, copper-nickel-chromium, and cadmium-nickel finish, with 400-800 mg. of cadmium per dm.<sup>2</sup>, was superior in corrosion-resistance to a copper-nickel finish, the thickness of nickel being constant. These finishes were inferior to heavy nickel or medium-heavy zinc deposits.—J. C. C.

A Rapid Determination of the Metal Content of Cadmium Baths. (Wogrinz.) See p. 254.

\*The Hardness of Electrolytic Chromium. Michel Cymboliste (Compt. rend., 1937, 204, (14), 1069-1071).- A systematic study was undertaken of the effect of the essential factors of electrolysis in chromic acid baths on the hardness of electrodeposited chromium. Large volumes of electrolyte were used so as to avoid the effect of variation of the chemical composition. The hardness was measured on a Vickers diamond pyramid tester with loads of 10-30 kg., and on a Eugène diamond cone machine with loads of 10-40 kg., the results being converted to Brinell hardness numbers. The deposits were always more than 0.5 mm. thick. It was found that the presence of anions (SO<sub>4</sub><sup>-</sup>, Cl<sup>-</sup>, &c.) diminishes the hardness, and that of cations (Na, K, Al, &c.) increases it, the more so the greater the concentration of ions. For a constant  $Cr^{vI}/SO_4$ ratio, increase in the content of chromic acid diminishes the hardness at bath temperatures of more than 55° C., increases it below 55° C., and has a minimum effect at that temperature. The maximum hardness was obtained at a temperature of about 50° C. Above 50° C., the effect of the temperature is the greater the lower the current density. By appropriately altering these various conditions, hardnesses of from 400 to 1200 could be obtained, the former being much lower than previous work would indicate.-J. H. W.

\*Lead-Silver Anodes for Chromium Plating.—I-II. Takeo Ishida ( $K\bar{o}qy\bar{o}$ Kwagaku Zasshi (J. Soc. Chem. Ind.), 1937, 39, (12)).—[In Japanese, with English summary in suppt., pp. 484-485.] By using the euteetic silverlead alloy for the anodes of chromium plating baths, the rate of anode corrosion is considerably reduced, probably owing to the fact that the grain-size of the metal is so small that the protective film of lead peroxide formed is more adherent and has less tendency to crack and flake off.—A. R. P.

\*The Crystal Structure of Copper Electrodeposits.—I. (Phillips and Meyer.) See p. 240.

Bright Nickel Plating. A Résumé of Technical Literature on the Subject. L. W. Johnson (J. Electrodepositors' Tech. Soc., 1937, 12, 93-103; and Met. Ind. (Lond.), 1937, 50, (9), 281-285; discussion, 285-286).—Recent British and American patents dealing with bright nickel plating are summarized, and a few papers which discuss the problem of producing bright nickel plates are reviewed. A bibliography of 24 references is appended.—A. R. P.

\*Sources of Organic Contaminants in Nickel Depositing Solutions and Methods of Purification. A. W. Hothersall and G. E. Gardam (J. Electrodepositors' Tech. Soc., 1937, 12, 81-92; and (condensed) Met. Ind. (Lond.), 1937, 50, (22), 609-612) .- Nickel deposits readily become pitted when the plating solution becomes contaminated with organic material such as that derived from cloth filters or wooden tanks. Birch and teak produce severely pitted, and whitewood and deal very hard and brittle, deposits. Solutions containing felt, calico, and silk yield lustrous, very brittle deposits, those containing calico being also exfoliated. Cotton and filter paper debris in a solution causes the deposits to be severely pitted, but matt. Addition of dextrin to nickel-plating solutions of  $p_{\rm H}$  5.9 increases the brightness of the deposits at first, but with more than 0.07 grm./litre cracking occurs; by making the solution more acid the deposits become more lustrous but more pitted. Gelatin considerably increases pitting at all  $p_{\rm H}$  values. The best method of removing deleterious organic impurities is to oxidize them with potassium permanganate under such conditions that hydrated manganese dioxide is precipitated and absorbs the oxidation products of the impurities; the solution is treated with sulphuric acid to  $p_{\rm H}$  3 and boiled with 0.1-0.2 grm. of permanganate per litre, then neutralized with nickel carbonate and treated with hydrogen peroxide to precipitate manganese dioxide. If the solution

contains chloride the permanganate treatment is carried out at  $35^{\circ}-40^{\circ}$  C. and the solution set aside for several days to allow the reaction to proceed.

-A. R. P.

A Resume of Silver Plating. Frank C. Mesle (1st Internat. Electrodeposition Conf. (London), Advance Copy, 1937, 8 pp.; and Met. Ind. (Lond.), 1937, 50, (12), 367-370).—For plating tableware, a strike solution containing silver 0.8-1.2 and potassium cyanide 52.5-67.5 grm./litre is used when the articles are not first nickel-plated; the final plating solution contains silver 24-32, potassium cyanide 30-45, and potassium carbonate 30-90 grm./litre. By operating at  $32^{\circ}$  C. a high current density (15 amp./ft.<sup>2</sup>) can be used without injurious effect on the plate. Current density influences considerably the distribution of the plate, too high a current density producing wide variations in the thickness deposited at different parts of the work. Methods of measuring the thickness of silver plate are briefly described and the results obtained by their use are compared.—A. R. P.

Testing and Stripping of Electrodeposits. I.—Silver. B. Egeberg and N. E. Promisel (*Metal Cleaning and Finishing*, 1937, 9, (1), 25–32, 37–40, 50).— To strip silver from nickel silver, cupro-nickel, copper, brass, bronze, or iron, the article is immersed in a 19:1 mixture of concentrated nitric and sulphuric acids at 85° C.; entire absence of water is essential for good results and the article must also be thoroughly degreased. From the loss in weight after stripping the amount of silver deposited per unit area may be determined. Silver is best stripped from Britannia metal, tin, iron, steel, and nickel by anodic treatment in a solution containing 4–6 oz./U.S. gall. of sodium cyanide using iron cathodes and a current density of 10–20 amp./ft.<sup>2</sup>. Nitric acid may be used for removing silver from stainless steel or aluminium. The hardness of silver plate measured on a micro-Brinell machine is about 70; this decreases to 24 on annealing at 340° C. and to 17 on annealing at 600° C. A light burnishing or buffing does not affect the hardness, but heavy polishing reduces it, owing to the annealing effect of the frictional heat developed. A method of testing wear-resistance is also briefly described.—A. R. P.

\*The Tinning of Steel Strip by Electrodeposition. I.-Electrodeposition and Polishing of Thin Coatings of Tin on Steel. D. J. Macnaughtan, W. H. Tait, and S. Baier (J. Electrodepositors' Tech. Soc., 1937, 12, 45-64; also Tech. Publ. Internat. Tin Res. Develop. Council, Series A, 1937, (52), 1-20; and Sheet Metal Ind., 1937, 11, (120), 347-353) .-- Continuous plating tests were carried out on the electro-tinning of 2-in. steel strips in an alkaline stannate bath using insoluble and soluble tin anodes and in an acid sulphate bath containing cresolsulphonic acid and organic additions. All three methods gave satisfactory plates, but the acid bath had the advantages that it could be worked cold, could be operated at a lower bath voltage, and plated at more than double the rate of the alkaline bath for the same current density. The speed of tinning in the acid bath is comparable with that used in the hot-dip tinning bath, but plated coatings are not nearly as lustrous as hot-dipped coatings. Polishing with precipitated chalk and Vienna lime produces a bright finish on plated coatings but removes 10-13% of the tin; a fairly uniform semi-lustrous surface is obtained with a loss of only 0.5% of the tin by scratch brushing with brass wire although the porosity is considerably increased by this treatment.

-A. R. P.

\*The Tinning of Steel Strip by Electrodeposition. II.—The Effect of Deformation on the Protective Value of Hot-Dipped and Electrodeposited Tin Coatings on Steel. D. J. Macnaughtan and J. C. Prytherch (J. Electrodepositors' Tech. Soc., 1937, 12, 65-80; and Tech. Publ. Internat. Tin Res. Develop. Council, Series A, 1937, (52), 21-36).—The protective values of hotdipped tin coatings and various types of electrodeposited coatings on steel were determined by porosity tests and the effect of stretching on the porosity

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was measured. The porosity of coatings obtained from alkaline baths is of the same order as that of hot-dipped coatings, but the composite coating obtained by a combination of these two processes is much less porous. A coarse matt tin deposit from an acid bath is more porous, and a smooth matt deposit from a similar bath slightly less porous, than a hot-dipped coating. When the coating thickness is increased from 0-00012 in. to 0.0003 in., the porosity is reduced by up to 75%. The composite tin coating, the hot-dipped coating, and the smooth matt acid coating show only a moderate increase in porosity on stretching 5%, whereas the other types of coating become much more porous. Micrographic examination indicates that failure of the alkali tin deposit and the coarse matt acid coating on stretching is due to their brittleness. The more ductile coatings consist of wide grains extending laterally over considerable distances, whereas the brittle coatings are generally small-grained and the crystals have their layers oriented more or less vertically from the place of deposition.—A. R. P.

The Present Status of Electrodeposition of Tungsten From Aqueous Plating Baths. M. L. Holt (Monthly Rev. Amer. Electroplaters' Soc., 1937, 24, (4), 252-261; discussion, 261-263).—Deposition of tungsten by electrolysis of a 12.5% solution of tungsten trioxide in 33% sodium carbonate solution at 90° C. does not occur if iron, nickel, and other readily plated metals are rigorously excluded. With small quantities of these metals in the solution an alloy plate is obtained containing about 30-35% tungsten when nickel is present and 15-35% iron when iron is present, but deposition ceases when the bath is depleted of the addition metals. The best way to introduce nickel is to percolate the solution continuously through a bed of nickel carbonate or to use a nickel anode. In all cases the cathode current efficiency is very low, usually only a fraction of 1%.—A. R. P.

\*Studies in Evaluating the Brightness of Electrodeposits. B. Egeberg and N. E. Promisel (1st Internat. Electrodeposition Conf. (London), Advance Copy, 1937, 11 pp; and Met. Ind. (N.Y.), 1937, 35, (4), 166-169.—The "brightness" or gloss (B) of a metal plate can be evaluated from the expression: B = $100[(S - D_0)/(S + D)]^e$ , where S is the value of specular reflection in any arbitrary units, D the sum of the values (in the same unit) of the diffuse reflections taken at discrete intervals,  $D_0$  is the value of diffuse reflection at 0°, and a is a constant of any arbitrary value (generally 8 unless the differences in brightness of the samples to be compared is small, in which case a may equal 50). A photometric method of measuring S,  $D_0$ , and D, and the construction of reflection distribution curves are described. Results obtained on various metal plates are briefly discussed.—A. R. P.

Bright Deposits, Thickness Control—Feature Plating Progress. Walter R. Meyer (*Metal Cleaning and Finishing*, 1937, 9, (2), 105–108, 130).—A review of plating progress during 1936, with 30 references.—A. R. P.

Control in Electrodeposition Processes. A. W. Hothersall (Metal Cleaning and Finishing, 1937, 9, (2), 121-124, 141-142; Found. Trade J., 1936, 55, (1048), 211-212; and Sheet Metal Ind., 1936, 10, (114), 791-792).—From a paper read before the British Association. Discusses: cleaning before plating, adhesion of the plate, rapid plating, control of acidity, defects in deposits, and the protective value of coatings, structure, and properties of electrodeposited coatings.—A. R. P.

Removal of Carbonates from Metal Cyanide Solutions. George B. Hogaboom (Met. Ind. (N.Y.), 1937, 35, (2), 64-66).—On cooling zine, copper, silver, or brass cyanide plating solutions to  $25^{\circ}$  F. ( $-4^{\circ}$  C.) all sodium carbonate in excess of about 9 oz./U.S. gall. crystallizes out as the decahydrate free from plating salts. Every 1 lb. of sodium carbonate so separated carries 1.7 lb. of water, so that when the solution is again diluted to its original volume it will contain even less carbonate; hence it is possible to reduce the carbonate still further by adding more anhydrous carbonate and then freezing out the decahydrate and diluting with water to the original volume.—A. R. P.

The Orientative Effects of the Geometrical and Crystalline Structure of the Basis Cathode on the Crystal Structure of Electrodeposits. Walter R. Moyer (Monthly Rev. Amer. Electroplaters' Soc., 1937, 24, (2), 95-105; discussion, 104-110).—A review of recent work, with a bibliography of 26 references. —A, R. P.

A Brush Plating Apparatus for the Laboratory. —— (Laboratory, 1936, 8, (4), 58-59).—Small objects may be replated with nickel, copper, cadmium, zinc, or tin by "painting" them with a brush containing an anode of the metal of the plate and wetted with an appropriate plating solution, the work being connected to the cathode terminal of a low-voltage 3-amp. rectifier. —A. R. P.

Plating Equipment. Materials of Construction. Edwin M. Baker (Metals and Alloys, 1936, 7, (11), 287-289, 296).—Sheet steel tanks are recommended for the usual alkaline cleaner baths and rubber-lined steel tanks for acid dips and acid electrolytes. The tanks for chromium plating baths should be lined with a 6% antimonial lead alloy.—A. R. P.

Design and Selection of Parts for Fume Exhaust Systems. B. F. Postman (*Metal Cleaning and Finishing*, 1937, 9, (2), 109–112, 139–140, 154).—Various types of hoods and ducts for exhausting spray and fumes from cleaning, pickling, and plating tanks are illustrated and their functions are described.

-A. R. P.

## VII.—ELECTROMETALLURGY AND ELECTROCHEMISTRY

(Other than Electrodeposition.)

#### (Continued from pp. 199-200.)

\*Storage Battery Life Tests. I.—Laboratory Life Testing. J. E. Hatfield and H. R. Harner (*Electrochem. Soc. Preprint*, 1937, (April), 375–388).—S. G. \*Storage Battery Life Tests. II.—Service Life Testing. J. E. Hatfield and H. R. Harner (*Electrochem. Soc. Preprint*, 1937, (April), 389–395).—A large number of experimental batteries were placed in automobile service, and the results of their performance were studied in an attempt to correlate laboratory and service life tests of lead-acid storage batteries. The results show positive plate failure, with buckling and cutting of separators, in all those batteries in which dense pastes were used in the older high-metal grids, and positive plate failure due to shedding in all those batteries in which low density pastes were used. With the newer type grids, using less metal and more active material, grid corrosion is the most important cause of failure. Of the two most used laboratory life testing methods, the "E" test (144 cycles per day, discharging at 300 amp. for only a few seconds) more nearly approximates to service results, while the other tests appear more useful for other laboratory purposes.—S. G.

#### VIII.-REFINING

Britannia Lead Refinery, Northfleet, Kent. J. O. Betterton and H. P. Wagner (Bull. Inst. Min. Met., 1937, (391), 18 pp.; discussion, (392), 14 pp.; and Met. Ind. (Lond.), 1937, 50, (17), 479–482).—The refinery treats the whole of the crude bullion produced at the Mount Isa smelter. The metal as received contains arsenic 0.05, antimony 0.3, copper 0.09%, and silver 85 oz./ton. Arsenic and antimony are removed in a softener which takes a charge of 320 tons of lead and is maintained at 650° C.; the slag obtained averages 20% antimony and is smelted to obtain antimonial lead. The softened bullion is

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desilverized by treatment with zinc, the high silver drosses being pressed and retorted to recover zinc and a rich silver-lead (4000-5000 oz. silver/ton). The desilverized lead containing 0.05 oz. silver/ton and 0.53% zinc is treated with chlorine at 380° C. which removes the zinc and all other impurities. Methods of treating the by-products to recover values and to obtain pure products for marketing are also described.—A. R. P.

Softening of Lead Bullion. Arthur E. Hall (*Trans. Amer. Inst. Min. Met. Eng.*, 1936, 121, 194–204).—Modern methods of softening lead bullion are discussed. Copper is eliminated to 0.05% by cooling the metal with agitation to a temperature just above the freezing point; addition of sulphur after the dross has been removed reduces the copper content to 0.01%. Arsenic, antimony, and tin are removed by selective oxidation processes at  $700^{\circ}$ -800° C. to produce lead arsenate-antimonate slags or by spraying the metal at 470° C. through molten oxidizing alkaline slags (Harris process). All these procedures are briefly described and their relative merits are discussed.

-A. R. P.

Debismuthizing Lead with Alkaline Earth Metals, Including Magnesium, and with Antimony. Jesse O. Betterton and Yurii E. Lebedeff (Trans. Amer. Inst. Min. Met. Eng., 1936, 121, 205-225) .- By careful control of the amount of calcium added (as a 5% calcium-lead alloy), of the temperature of addition and of drossing, and of the time of mixing, it is possible in a series of 5-7 operations to reduce the bismuth content of lead from 1% to about 0.05-0.06%. With lead containing higher proportions of bismuth, magnesium effects a more rapid reduction of the bismuth content at a smaller cost than calcium, but does not reduce the final percentage. With a 3:1 magnesiumcalcium ratio (added as a lead alloy) the bismuth may be reduced to 0.02%, probably because the Mg<sub>2</sub>Bi<sub>2</sub> and Mg<sub>2</sub>Ca<sub>2</sub> compounds exert a mutual depressing effect on their solubilities in molten lead. If a small quantity of antimony is added to the lead before the calcium-magnesium treatment it is possible to remove all but 0.005% of bismuth. The process is worked in several stages on the countercurrent principle so that the dross obtained in the first stage contains about 20% bismuth; when this is melted under appropriate alkali fluxes it separates into a bismuthide product containing 50% bismuth with 5% each of calcium and magnesium, and a low bismuth-lead alloy which is returned to the process. The history of the development of the process is described and fairly full operating details are given.—A. R. P.

Continuous Lead Refining at Port Pirie, South Australia. G. K. Williams (*Trans. Amer. Inst. Min. Met. Eng.*, 1936, 121, 226–263).—A complete description of the process and of the plant with diagrams and flow-sheets is given.—A. R. P.

Chlorine Dezincing in Lead Refining. Jesse O. Betterton (*Trans. Amer.* Inst. Min. Met. Eng., 1936, 121, 264–270).—Lead from the desilverizing kettle is pumped to a dezincing kettle at 350° C. and the dezincing machine lowered into position. This machine consists of a pump which forces the lead continuously through a closed cylinder in which it meets a stream of chlorine from the storage tank and from which it is discharged in a vortex below the lead surface in the kettle. Since the reaction is vigorous and exothermic, practically no external heat is required and the gas pressure in the cylinder can be maintained at 3–5 in. of mercury so that no chlorine escapes into the atmosphere. The rate of circulation of the lead is 10 tons/minute and chlorine is admitted at 500 lb./hr., so that a 200-ton charge is treated in 4–5 hrs. The zine content is reduced below 0-055%, and the zine chloride produced is readily refined for sale as a soldering flux or for chemical operations by simple treatment with molten zine which removes all the lead.—A. R. P.

Electrolytic Lead Refinery, Betts Process, the Consolidated Mining and Smelting Company of Canada, Limited. P. F. McIntyre (*Trans. Amer. Inst.*  Min. Met. Eng., 1936, 121, 271-282).—The electrolyte used (d 1·21) contains lead 67, total hydrofluosilicic acid 142, and free acid 95 grm./litre and is circulated at 40°-50° C. through the cells at 3-4 gall./minute. The lead anodes contain copper 0·035, antimony 0·63, arsenic 0·31, tin 0·038, bismuth 0·02, and lead 98·77% with gold 0·423 and silver 49·9 oz./ton. The current density used is 18·5 amp./ft.<sup>2</sup> and the voltage 0·3-0·4 rising eventually to 0·65-0·7. The anode slimes (1·5-1·75% of the original anodes) are smelted to bullion which is softened and cupelled to recover the precious metals; the litharge is reduced to metal and the bismuth recovered by a second electrolytic treatment.—A. R. P.

The Betts Process at Droya, Peru, S.A. T. E. Harper and Gustave Reinberg (*Trans. Amer. Inst. Min. Met. Eng.*, 1936, 121, 283-288).—In this plant, which is operated in a similar way to the Canadian plant (see preceding abstract), the anodes contain lead 90·1, copper 0·12, arsenic 1·9, antimony 3·3, and bismuth  $4\cdot4\%$  and the cathodes produced contain lead 99·998, copper 0·0001, arsenic 0·00005, antimony 0·0004, and bismuth 0·0005\%, while the slimes contain lead 19-20, copper 0·8, arsenic 12-13, antimony 23-24, and bismuth 30-31\% with 280 oz. of silver per ton.—A. R. P.

New Jersey Company Process for the Refining of Zinc by Redistillation. W. M. Peirce and R. K. Waring (*Trans. Amer. Inst. Min. Met. Eng.*, 1936, 121, 445-452).—The fractional distillation process through a series of silicon carbide tray-type rectifying columns is described, and the plant illustrated. The process gives a 96% yield of 99.99 + % zinc from any grade of commercial zinc; in addition all the lead, cadmium, gallium, and indium in the crude metal may be recovered by suitable modifications of the process.—A. P.

#### IX.—ANALYSIS

#### (Continued from pp. 200-202.)

Practical Possibilities in Spectrographic Analysis. George R. Harrison (*Metals and Alloys*, 1936, 7, (11), 290-296).—The principles of modern spectrographic analysis are explained, and some account is given of the construction and use of various necessary apparatus. The uses of the method for rapid analyses in the metal industry is also described.—A. R. P.

\*Quantitative Spectrographic Analysis. Increased Accuracy in the Logarithmic Sector Method. Harley A. Wilhelm (*Indust. and Eng. Chem. (Analyt. Edn.*), 1937, 9, (4), 170–172).—A new type of eye-piece for making readings on sector lines is described and illustrated; its essential features are an internal scale and internal comparison densities. The mean error obtained by its use is  $\pm 0.060$  mm. which is about one-third that obtained with the ordinary measuring eye-piece.—A. R. P.

Contributions to Applied Spectrographic Analysis in the Metalworking Industries. II.—On an Effective Vibrationless Mounting for the Mirror Galvanometer. G. Heidhausen (*Mitt. Forsch. Anst. G.H.H.-Konzern*, 1937, 5, (2), 27-30).—A vibrationless method of mounting the mirror galvanometer used in the photometric measurement of the lines on the spectrographic plate is described with reference to a diagram and illustration.—A. R. P.

Splitting Small Samples Accurately with the Microsplitter. — (Eng. and Min. J., 1937, 138, (4), 185–186).—An illustrated description of a microsplitter, originally developed for ore analysis.—R. Gr.

\*A New Reagent for the Detection of Cerium. J. F. Miller (Indust. and Eng. Chem. (Analyt. Edn.), 1937, 9, (4), 181–182).—The test is made on a sulphate solution which has been boiled with  $Na_2S_2O_8$  or treated with Na bismuthate to oxidize the Ce<sup>III</sup> to Ce<sup>IV</sup>; the cold solution is then treated with 5 c.c. of 5% Na arsanilate solution which produces a pink to red-brown solution in the presence of Ce. Zr, Co, and Cr interfere.—A. R. P.

A Rapid Determination of the Metal Content of Cadmium [Plating] Baths. A. Wogrinz (Metallwaren-Ind. u. Galvano-Tech., 1937, 35, (5), 117-118).— The Cd is precipitated as CdS by addition of NaCN and Na<sub>2</sub>S, the washed precipitate is dissolved in HNO<sub>3</sub> and the Cd precipitated as CdCO<sub>3</sub> by addition of Na<sub>2</sub>CO<sub>3</sub> to the boiling solution. The CdCO<sub>3</sub> is collected, washed with 2%NaNO<sub>3</sub> solution until neutral and dissolved in a measured volume of 0.5N-H<sub>2</sub>SO<sub>4</sub>. Titration of the excess acid with 0.5N-NaOH affords data for calculating the Cd present.—A. R. P.

\*The Rapid Analysis of Zinc-Sodium Amalgams. Herman A. Liebhafsky (Indust. and Eng. Chem. (Analyt. Edn.), 1937, 9, (4), 176).—The amalgam (50-75 grm.) is whirled in a conical flask for 20 seconds with an excess of N-H<sub>2</sub>SO<sub>4</sub> and the excess of acid is then titrated with 0.5N-NaOH using phenolphthalein as indicator. The amalgam, which is now free from Na is transferred to a cell of the H-type and its e.m.f. is measured against a Zn amalgam of known concentration using as electrolyte a M-ZnSO<sub>4</sub>-0.05M-H<sub>2</sub>SO<sub>4</sub> solution. The Zn concentration of the unknown amalgam is then calculated from the Nernst equation :  $E = RT/NF \log_{c}[Zn]/[Zn]_{2}$ .—A. R. P.

\*The Determination of Gold [in Precious Metal Alloys]. F. É. Bcamish, J. J. Russell, and J. Seath (*Indust. and Eng. Chem. (Analyt. Edn.*), 1937, 9, (4), 174-176).—The alloy is dissolved in *aqua regia* and the solution evaporated to dryness with about 1 grm. of NaCl, the residue being moistened with HCl and dried 3 times to expel HNO<sub>3</sub>. The final residue is extracted with 1:9 HCl, the solution filtered, and any insoluble matter washed with 10% HCl. The Au is then precipitated from the boiling solution with 5% hydroquinone solution added drop by drop, 3 c.c. being required for every 25 mg. of Au. The coagulated precipitate is collected on a close filter paper, washed with boiling H<sub>2</sub>O, and ignited for weighing. Pt and Pd do not interfere unless the amount present is more than double that of the Au, in which case re-precipitate the Au from a cold solution allowing 2 hrs. for completion of the reaction.—A. R. P.

\*Spectrographic Determination of Platinum [in Dental Alloys] by the Constant-Pair Method. James J. Manning and James Coull (Indust. and Eng. Chem. (Analyt. Edn.), 1937, 9, (1), 28-29).—The alloy is dissolved in aqua regia and portions of the solution are mixed with known volumes of a standard Mo solution. The mixtures are then spectrographed in a graphite are and the intensity of the lines Pt 2893.8 and Mo 2871.5 compared; when these are equal the concentrations of Pt and Mo in the solution are equal and hence the Pt content of the alloy can be calculated.—A. R. P.

\*Reactions of Scandium at the Dropping Mercury Cathode [Detection and Determination of Scandium in Presence of Aluminium]. R. H. Leach and H. Terrey (*Trans. Faraday Soc.*, 1937, 33, (3), 480–486).—The deposition potential of scandium at the dropping mercury cathode is  $-1.84 \pm 0.01$  v. relative to the N-calomel electrode. The polarographic method can be used for the detection and determination of Sc in the presence of Al.—A. R. P.

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

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

#### (Continued from p. 202.)

A Transparent Mounting for Microsections. E. A. Erdman (Metals and Alloys, 1937, 8, (1), 27).—A transparent methyl acrylate resin is used instead of Bakelite in the usual press-moulding method of mounting specimens for micrographic examination. The resin is baked at  $120^{\circ}$  C. under a pressure of 4000 lb./in.<sup>2</sup> and cooled to 85° C. before removal from the press; it then

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forms a clear, colourless, transparent block through which the whole of the embedded object may be seen.—A. R. P.

Microphotographic Apparatus for the Examination of Opaque Objects. Carl Zeiss, Ltd. (J. Sci. Instruments, 1937, 14, (3), 109-110).—A description of the "Metalliput" apparatus. The instrument uses the principle of the inverted microscope, and can be used for both visual and photographic work. ....W. H.-R.

Apparatus for Measuring Large Expansions with Great Accuracy. Josef Pirkl and Theodor Povsche (*Mitt. Tech. Versuchsamtes*, 1936, 25, 4–11).— The construction of an apparatus for measuring expansions or elongations up to 4 mm. with an accuracy of 0.001 mm. is described with reference to diagrams and illustrations.—A. R. P.

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

(Continued from pp. 202-203.)

A New Test for Relative Sliding Wear. Donald S. Clark and Robert B. Freeman (Metal Progress, 1937, 31, (4), 399-401).—Continuation of work by Freeman, *ibid.*, (3), 281-284. The energy required for the removal of unit volume of material from a polished specimen moved under a diamond point at a constant rate is used to measure the resistance of the material to sliding wear. The apparatus employed is described and illustrated. —P. M. C. R.

Testing Metals for Severe Service. H. W. Gillett (Metals and Alloys, 1937, 8, (4), 101-105).—A correlated abstract, in which are discussed the wear and corrosion testing of metals, weldability, and work-hardening.—A. R. P.

\*A Dynamically-Loaded Bearing-Testing Machine. O. Heyer (Luftfahrtforschung, 1937, 14, (1), 14–25; Bull. B.N.F.M.R.A., 1937, (97)).—Describes a machine designed to reproduce conditions of service of main bearings of aircraft engines. Results of tests are given on bronze-backed lead bearing metal, steel-backed lead-bronze, and steel-backed cadmium-nickel (3% nickel).—S. G.

Methods of Measuring Stresses in Thick-Walled Small-Diameter Tubes. N. N. Davidenkov (Metallurg (Metallurgist), 1936, (12), 33-35).—[In Russian.] The methods of Sachs, Davidenkov, and Kalakutskiy are compared; Davidenkov's is the most reliable since it requires measurements with an accuracy of  $5-6\mu$ . Davidenkov's formulæ require correction when applied to thick-walled tubes.—N. A.

Recommendations for Leaded Gun-Metals. The Most Suitable Type of Test-Piece. H. J. Roast (*Met. Ind.* (*Lond.*), 1937, 50, (6), 189–191).—Reports tensile and hardness tests on 9 "keel bar" and 8 "cast to size " test-bars from 3 melts of "G.M.2 metal" (copper 87, tin 9, zinc 3, lead 1%). It is concluded that the "keel bar" specimen gives most concordant test results.—J. C. C.

\*Hydrostatic Pressure Method for Determining Surface Tension of Liquid Metals. Raymond E. Myers (*J. Dental Research*, 1936, 15, (5), 321).—Abstract of a paper read before the International Association for Dental Research. A cylindrical vessel of suitable refractory with a small hole in the centre of the bottom is gradually filled with the molten metal and the height to which the metal can be raised before flowing through the opening determined. From this value, the radius of the hole, and the density of the metal at the temperature of the test it is possible to calculate the surface tension.—A. R. P.

## RADIOLOGY.

X-Rays Among the Metals. Ancel St. John (Metal Progress, 1936, 30, (4), 162–166).—A review of the methods and applications of X-ray examination

of metals, with special reference to the 1936 edition of the Metals Handbook, published by the American Society for Metals.—P. M. C. R.

Radiography of Composite Gold Plate. W. J. Wrighton and Tracy C. Jarrett (*Metals and Alloys*, 1937, 8, (3), 78–79).—X-ray photographs of gold on bronze (rolled gold) made with an intermediate solder layer show readily the quality of the weld. Examples are illustrated.—A. R. P.

On Two Recommended Methods of Switching Universal X-Ray Outfits for Mechanical Testing. Fritz Regler (*Mitt. Tech. Versuchsamtes*, 1936, 25, 20-31).—The electrotechnical principles of constructing an X-ray outfit which can be adapted by suitable switches for use in the three fields of material testing are deduced from theoretical considerations. Wiring diagrams are given for fixed and portable outfits.—A. R. P.

## XII.—TEMPERATURE MEASUREMENT AND CONTROL

#### (Continued from p. 111.)

Pyrometry, Thermoelectric, Optical, and Radiation. [Kirtland Marsh. H. Dike] (*Metal Progress*, 1936, 30, (4), 167–170, 172, 174, 186).—Summary of papers in the 1936 edition of the Metals Handbook (American Society for Metals) are reproduced; they include a discussion of thermocouple materials, of the relative merits of optical and thermoelectric pyrometers, and of the causes and correction of faults in pyrometers.—P. M. C. R.

\*On Platinum Resistance Thermometry. IV.—Determination of Constants in Van Dusen's Equation. Mototarō Matsui, Zenzyuro Kuroda, and Rituo Yumen (Kōgyō Kwagaku Zassi (J. Soc. Chem. Ind.), 1936, 39, (12)).—[In Japanese, with English summary in suppt., pp. 472–473.] Measurements at the boiling point of oxygen and the sublimation point of earbon dioxide gave the following values for the constants of Van Dusen's equation for the resistance of platinum at low temperatures.  $R_t/R_0 = 1 + 3.9701 \times 10^{-3}t - 5.841 \times 10^{-7}t^2 - 4.42 \times 10^{-12}(t - 100)t^3$ .—A. R. P.

\*An Experimental Study of the Absolute Temperature Scale. II.—The Reproducibility of the Sulphur Point. The Effect of Pressure on the Sulphur Point. James A. Beattie, Manson Benedict, and B. Edwin Blaisdell (*Proc. Amer. Acad. Arts Sci.*, 1937, 71, (6), 327-360).—The factors affecting the reproducibility of the sulphur point are investigated, and apparatus for controlling and reproducing the sulphur point to within about  $0.002^{\circ}$  C. is described. In the range 660-860 mm. the temperature  $t^{\circ}$  C. (Int.) of equilibrium between liquid sulphur and its vapour at a pressure p standard mm. of mercury is given by the relation  $t = 444 \cdot 6 + 0.0908028$  (p - 760) – 0.000004351 (p - 760)<sup>2</sup> + 0.0000004361 (p - 760)<sup>3</sup>.—W. H.-R.

\*An Experimental Study of the Absolute Temperature Scale. III.—The Reproducibility of the Steam Point. The Effect of Pressure on the Steam Point. James A. Beattie and B. Edwin Blaisdell (*Proc. Amer. Acad. Arts Sci.*, 1937, 71, (7), 361–374).—See also preceding abstract. An apparatus for controlling and measuring the temperature of equilibrium between water and its saturated vapour is described. The reproducibility of the steam point is  $\pm 0.0003^{\circ}$  C. The temperature t° (Int.) of equilibrium between water and its saturated vapour at a pressure p standard mm. over the range 660–860 mm. is given by the relation  $t = 100 + 0.0368578 (p - 760) \times 0.000020159 (p - 760)^2 + 0.00000001621 (p - 760)^3.—W. H.-R.$ 

\*An Experimental Study of the Absolute Temperature Scale. IV.—The Reproducibility of the Mercury Boiling Point. The Effect of Pressure on the Mercury Boiling Point. James A. Beattie, B. Edwin Blaisdell, and Joseph Kaminsky (*Proc. Amer. Acad. Arts Sci.*, 1937, 71, (8), 375–385).—See also preceding abstracts. The boiling point of mercury is suggested as a fourth calibration

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point in the range 0-500° C., the other points being those of ice, steam, and sulphur. An apparatus suitable for reproducing the mercury point with a probable error of  $\pm 0.0010^{\circ}$  C. is described. The effect of pressure on the boiling point of mercury is investigated experimentally, and is given by the relation  $t_{\rho} = 356\cdot580 + 0.0730951$   $(p - 760) \times 0.000030866$   $(p - 760)^2 + 0.0000003191$   $(p - 760)^3$ , where  $t_p$  is on the International Temperature Scale. The normal boiling point of mercury on the absolute temperature scale is  $356\cdot66 \pm 0.02^{\circ}$  C.—W. H.-R.

## XIII.—FOUNDRY PRACTICE AND APPLIANCES

#### (Continued from pp. 203-201.)

Recent Development Tendencies in Casting Ingots and Bars of Light Metals. H. Röhrig (Aluminium, 1937, 19, (2), 51-53; discussion, 70-71; and (summary) Met. Ind. (Lond.), 1937, 50, (12), 360.—R. discusses methods which have recently been proposed for preventing inclusions of oxide films and segregation of the constituents and for obtaining a fine-grained uniform structure in light metal ingots. Water-cooled and tilting moulds are satisfactory in most respects, but have a tendency to produce wave-like formations along the edges. A more recent development is the use of a vertical mould with a slit in one side into which the pouring spout protrudes to the centre of the mould ; as the mould fills it sinks and the slit below the spout is automatically closed so that the end of the spout is close to the surface of the metal throughout the pour, thus obviating turbulence. A modification of this principle has been adopted for casting long rods, a short mould with a removable bottom being used and the bottom removed when a length of metal has solidified so that the ingot as it is formed gradually sinks through the mould, the level of the metal in which is kept constant. A method has also recently been devised for casting thick sheet directly through watercooled rolls so that as the metal solidifies in the roll gap it is extruded at the other side as sheet.-A. R. P.

Constructional and Finishing Practice with Light Metal Castings. W. Hartl (*Aluminium*, 1937, 19, (2), 71-86).—Modern methods of casting and finishing complicated castings of light metal alloys for use in the aircraft and electrical industries are described, and precautions to be observed in designing new structures are reviewed.—A. R. P.

Removal of Aluminium Oxide from Aluminium Alloys. G. Vainshied (Novosti Tekhniki (Tech. News), 1936, (15), 22-23; C. Abs., 1937, 31, 2150). —[In Russian.] An alloy of high quality, without admixture of alumina, was obtained by stirring molten alloy by means of a stream of nitrogen for 8-10 minutes; this causes alumina to float on the surface.—S. G.

The Manufacture of Oxygen-Free High-Conductivity Copper. Edwin F. Cone (Metals and Alloys, 1937, 8, (2), 33-37).—Modern American practice is described. A reverberatory furnace is used for melting the metal and is continuously supplied with new metal at one end; the charge in the furnace is poled to 0.03-0.05% oxygen and continuously overflows through a closed trough into a furnace filled with glowing charcoal which removes the whole of the oxygen content. Casting is done in an atmosphere of burnt gas containing carbon monoxide 27-28, carbon dioxide 0.5, and nitrogen 72.5-71.5\%. —A. R. P.

Founding of Aluminium Bronze. J. E. Crown (Trans. Amer. Found. Assoc., 1936, 44, 359-366; discussion, 367-372; also Met. Ind. (Lond.), 1936, 49, (7), 153-155; and (summary) Light Metals Rev., 1936, 2, (23), 419-420).—A description is given of the melting, pouring, and forging of aluminium bronze and of the associated moulding practice employed in the

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U.S. Naval Gun Factory. The discussion contains useful data concerning melting and moulding procedure.—W. D. J.

Production of Aluminium Bronze Castings to Withstand High Pressure. M. T. Ganzauge (*Trans. Amer. Found. Assoc.*, 1936, 44, 479-491; discussion, 492-495; also Foundry, 1936, 64, (6), 24-25, 82-84; and *Met. Ind. (Lond.)*, 1936, 48, (20), 559-562, 570).—A detailed description is given of the melting, moulding, and pouring practice used in the production of seven different types of aluminium bronze castings. Reference is made to the use of carbon dioxide for removing air from moulds prior to pouring.—W. D. J.

Melting and Casting of Aluminium Bronzes. Edmund R. Thews (Met. Ind. (N.Y.), 1937, 35, (2), 59-63).—The difficulties inherent in casting aluminium bronze due to the superficial oxide film are discussed, and methods for overcoming them in practical foundry operations are described, with especial reference to proper gating and sprueing in sand-casting.—A. R. P.

Manganese Bronze. A Correlated Abstract. (Hensel.) See p. 233.

Lead in Silicon Bronze May Cause Trouble. N. K. B. Patch (Foundry, 1937, 65, (1), 34, 78).—Additions of lead to silicon bronze are likely to lead to the formation of lead silicate, with deleterious results to the machinability. The mould design for the production of a casting in an 85:5:5:5 brass alloy is discussed.—W. D. J.

Zinc Bronze-Composition "G." Treating It for Pressure Tightness. Francis G. Jenkins (*Metals and Alloys*, 1936, 7, (11), 279–286; and *Found*. *Trade J.*, 1936, 55, (1C61), 464–466, 480).—Practical methods of casting Admiralty gun-metal to obtain sound, gas-free castings are discussed. The recommended procedure is as follows: The alloy is melted in a slightly oxidizing atmosphere in a gas- or oil-fired furnace, deoxidized with 0.05% phosphorus added as phosphor-copper just prior to casting, and, after thorough stirring and settling, cast at 1100°-1200°C. The castings should be homogenized and relieved of internal stress by annealing at 760°C. for 1 hr. for every 1 in. of wall thickness. To reduce the grain-size up to 0.3% of lead or 0.75% of nickel or both may be added to the charge.—A. R. P.

Scoop Sampling of Molten Brass. L. Kroll, E. A. Anderson, and F. E. Ball (*Metals and Alloys*, 1937, 8, (1), 25).—Two pots of brass are heated under similar conditions in two gas-fired furnaces, one pot of metal serving as a preheater for the tubular carborundum scoop, which is first preheated in an electric resistance furnace to  $80^{\circ}-90^{\circ}$  C. below the metal temperature and then immersed in the preheater pot for 5 minutes, after which it is withdrawn quickly, shaken to remove the metal and plunged into the pot of metal to be sampled. When full of metal, it is raised and a piece of copper, previously cooled in solid carbon dioxide, is dropped on the surface of the metal in the scoop to cause it to solidify quickly. The whole is then quenched in mercury held at its melting point by being surrounded with solid carbon dioxide. The scoop is then broken away and the ingot of brass sectioned for macroscopic examination. The method is particularly suitable for studying gas distribution since all the gas present in the molten metal is retained and the shrinkage cavity is kept internal by the rapid quenching.—A. R. P.

Iron Mould for Lead Casting. —— (Foundry, 1937, 65, (3), 74).—The possibilities and design of an air- or water-cooled iron mould for casting lead are discussed.—W. D. J.

\*The Behaviour of Molten Iron, Nickel, and Manganese Towards Their Molten Silicates and Solid Silica at 1600°. Willy Oclsen and Gottfried Kremer (*Mitt. K.-W. Inst. Eisenforschung*, 1936, 18, (8), 89–108).—The deoxidizing effect of manganese and silicon and of mixtures of these on molten iron, nickel, and nickel-iron alloys under silicate slags is shown in a series of tables and graphs. When manganese is added to molten nickel under a nickel silicate slag at 1600° C. no manganese enters the metal layer until practically the

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whole of the nickel oxide in the slag and metal has been reduced to nickel; molten nickel, therefore, has practically no reducing action on molten manganese silicate slag, equilibrium being reached at 1600° C. when the metal contains 0.2% manganese and the slag 0.6-1% nickel oxide. With further addition of manganese, silicon is reduced from the slag; thus with 3.2% manganese in the metal 0.7% silicon is reduced. Addition of iron to the molten nickel increases the silicon and manganese contents of the metal at the equilibrium stage and reduces almost to zero the nickel oxide content of the slag. -A, R, P.

Casting Tubes and Wire Rods. — (Met. Ind. (Lond.), 1937, 50, (16), 455-456).—A description, based on patent information, is given of a continuous process for making "draw castings" of rods and tubes in copper, brass, and other non-ferrous metals. Molten metal is supplied at one end of a mould, and a solid casting withdrawn from the other. The essential feature of the process is that, in order to prevent the formation of a weak radial crystal structure, the latent heat must be withdrawn, not through the mould walls, but through the already solidified metal. Superior properties are claimed for the castings so produced.—J. C. C.

Gates and Risers for Large Non-Ferrous Castings. Adam Dunlop (Found. Trade J., 1937, 56, (1071), 177–180).—Read before the Scottish Branch of the Institute of British Foundrymen. The principles governing the production of sound castings in bronze and high-tensile brass alloys are outlined. The causes of interdendritic shrinkage defects and dirty and misrun castings are discussed. Examples of methods of gating typical eastings are described, including those for a 30 ft. liner, a condenser door casting, and a centrifugal pump cover in gun-metal; and a four-bladed propeller and a 5 ft. diameter hemi-spherical bowl in high tensile brass.—J. C. C.

More Non-Ferrous Problems. F. Dunleavy (Found. Trade J., 1937, 56, (1078), 316-317).—Read before the Bristol Section of the Institute of British Foundrymen. The arrangement of runners to prevent sponginess in a leaded bronze sleeve casting, corebox design and the use of chills in the centrifugal casting of worm gear blanks, and venting problems in casting large aluminium rings are discussed.—J. C. C.

Industrial Propane for Flame Cutting and General Foundry Use. F. H. Andrews and E. A. Jamison (*Trans. Amer. Found. Assoc.*, 1936, 44, 324–333; discussion, 333–336).—A description of the application of propane to the foundry especially for removal of gates and risers and as a fuel for annealing, core baking, mould drying, ladle heating, and for flame cutting. Operating and cost data are included.—W. D. J.

Recent Developments in Rapid Core-Making. Victor Stobie (Found. Trade J., 1937, 56, (1073), 215-216; and Met. Ind. (Lond.), 1937, 50, (15), 437-438).—Read before the Newcastle Branch of the Institute of British Foundrymen. In a new core-making machine, sand is delivered at high speed from a nozzle at the end of a flexible tube into the core box, and, being free from entrapped compressed air, packs itself firmly into place. In earlier machines, the air pressure in the core box increased as it was being filled, the speed of the entering sand was progressively reduced, and thus the density of the core was not uniform.—J. C. C.

Mould and Core Drying by Modern Methods. W. H. Smith (Found. Trade J., 1937, 56, (1069), 142-144; discussion, (1070), 162).—Read before the Scottish Branch of the Institute of British Foundrymen. Large moulds made on the floor may be dried rapidly by coke-fired mould dryers. For stoving, the forced-draft type of stove ensures most uniformly consistent results. The use of automatic stokers, "short period" firing, methods of charging and discharging stoves, and the Acme system of continuous core drying are briefly discussed. In the discussion, reference was made to drying methods involving

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the control of humidity in the stove and its gradual reduction from an initially high value (produced by injecting steam) in order to prevent surface cracking.

-J. C. C.

A.F.A. Grain Distribution Numbers for Foundry Sand. Tentative Standard. W. G. Reichert, Paul Bechtner, C. Mathiesen, and C. M. Saeger, Jr. (Trans. Amer. Found. Assoc., 1936, 44, 545-551) .- This method was prepared by the Sub-Committee on Grading of the A.F.A. Foundry Sand Research Committee, was submitted to the latter committee for review and is approved as a Tentativo Standard.-S. G.

Foundry Sand Testing Problems at High Temperatures. P. E. Kyle (Trans. Amer. Found. Assoc., 1936, 44, 401-414) .- A description of testing moulding sands for fusion, sintering, expansion and contraction, flowability, compressive strength, and permeability. Recommendations for research and a bibliography of 13 references are included .- W. D. J.

Die-Casting Machines for High Melting Point Alloys. ---- (Met. Ind. (Lond.), 1937, 50, (7), 217–218).—A brief description of the Bühler die-casting machine. Closing of the die is effected by tension, the die-closing mechanism and the injection plungers being operated from a hydro-pneumatic accumulator .- J. C. C.

Foundry Mechanization. A. S. Beech (Found. Trade J., 1937, 56, (1073), 201-211; (1074) 233-235; discussion, 235-236).—Read before the Falkirk Section of the Institute of British Foundrymen. Examples of mechanization in large and small (ferrous) foundries are described. It is urged that mechanization in some form can be adopted with advantage to improve the quality of the product and the working conditions in all foundries .- J. C. C.

Progress of Safety and Hygiene in the Foundry. I .- Medical Aspects. II.-Legislative Aspects. III.-Open Forum. (I) Roy R. Jones. (II) Voyta Wrabetz (Trans. Amer. Found. Assoc., 1936, 44, 554-564, 565-575, 576-588). -S. G.

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

Conservation of Aluminium Scrap. A. E. Peters (Machinist (Eur. Edn.), 1937, 81, (11), 172E).-A brief note on the precautions to be taken in melting aluminium scrap .-- J. H. W.

## XV.-FURNACES AND FUELS

## (Continued from pp. 204-205.)

Forced Convection Heating and Its Control. Leroy A. Lindberg (Heat-Treat. and Forging, 1937, 23, (1), 37-39, 44).—The principles and construction of several furnaces fitted with forced air circulation are described. Temperature control is also discussed .-- W. D. J.

Constructing Brass Furnaces. — (Foundry, 1937, 65, (1), 27, 78).— The principles of design of gas-fired pit-type furnaces are discussed, and constructional data together with dimensions are given .-- W. D. J.

Changes in Gas Furnace Construction Cut Melting Cost. J. B. Nealey (Foundry, 1937, 65, (2), 32-33).—An account of the improvements in design in the gas-fired pit furnaces of a New Jersey (U.S.A.) brass foundry.

-W. D. J.

Some Recent Gas Furnace Developments and Installations. H. M. Heyn (Heat-Treat. and Forging, 1937, 23, (1), 40-44).—Recent developments in gas-fired furnaces are described in detail, with particular reference to the applica-tions of gas-fired radiant tube heating.—W. D. J.

Electric Furnaces for the Non-Ferrous Metals Industry. Gerh. Simon (Metall u. Erz, 1936, 33, (23), 615-617; (24), 643-647) .-- Modern types of crucible and hearth resistance furnaces and of low- and high-frequency induction furnaces for melting aluminium, copper, copper alloys, and nickel alloys are illustrated and described, and their advantages briefly discussed.

-A. R. P.

Electric Heat-Treating Developments in England. A. G. Robiette (*Heat-Treat. and Forging*, 1937, 23, (2), 92–94, 96–97).—The following aspects of heat-treatment equipment are discussed: multi-zone vertical pit furnaces, salt-baths fitted with tubular immersion heaters, "pan-dumping" systems, cracked and burned ammonia, partially burned coal-gas, bright-annealing furnaces, electric furnace brazing, and other recent developments.—W. D. J.

Heat-Treating Aluminium Alloys. — (Elect. Times, 1937, 91, (2374), 551-552).— A brief illustrated account of the Kaercher salt-bath furnaces, in which uniform temperature distribution is obtained by using special immersion heaters, arranged only along the bottom of the bath.—J. C. C.

## XVI.-REFRACTORIES AND FURNACE MATERIALS

#### (Continued from p. 205.)

Refractory Trends and Developments During 1936. John D. Sullivan (*Heat-Treat. and Forging*, 1937, 23, (1), 27-30).—Improvements in the quality of fireclay bricks have occurred in 1936. Double-fired bricks and bricks fired at considerably higher temperatures have appeared on the market. The use of insulating materials, particularly Vermiculite, for furnaces is increasing. No changes in composition of silica bricks have occurred, but they are now manufactured more accurately to size. The use of basic brick in the United States and Canada is increasing but not so rapidly as in England. European developments in connection with magnesite brick are described. Other refractory materials are briefly discussed.—W. D. J.

Recent Improvements in Refractory Materials. P. B. Robinson (Found. Trade J., 1937, 56, (1072), 187–189).—Read at a joint meeting of the Northern Section of the Coke Oven Managers' Association, the Newcastle-upon-Tyne Branch of the Institute of British Foundrymen, and the North-East Coast Section of the Institute of Metals. A general account is given of the characteristics of the SiO<sub>2</sub>-Al<sub>2</sub>O<sub>3</sub> system, the influence of impurities, and the properties and applications of firebricks, silica bricks, basic bricks, and jointing materials.—J. C. C.

#### XVII.—HEAT-TREATMENT

#### (Continued from pp. 113-114.)

The Bright-Annealing of Metals. A. G. Robiette (*Met. Ind. (Lond.)*, 1937, 50, (16), 457-461).—Read before the Manchester Metallurgical Society. The physico-chemical conditions which must be satisfied for bright-annealing are outlined and an account given of modern industrial furnaces and their applications. Reference is made to the use of burnt ammonia regenerated in a closed system and of town gas purified from organic sulphur compounds as cheap protective atmospheres.—J. C. C.

**Removing Stains from Brass Coils.** A. G. Arend (*Met. Ind.* (N.Y.), 1937, 35, (2), 57–58).—Stains produced during annealing of brass coils in fuel-fired furnaces are readily removed by anodic treatment in 8% sodium hydroxide solution to which a small quantity (determined by experiment) of sodium chloride is added.—A. R. P.

Quenching Monel Metal and Pure Nickel. W. E. Warner (Machinist (Eur. Edn.), 1937, 81, (7), 121E).--A very brief note. In the heat-treatment of Monel metal and pure nickel a quenching bath of 1 part of wood alcohol and 80 parts of water is recommended. The articles should be put into the bath at a bright yellow heat.—J. H. W.

Defects in Heat-Treatment. A. A. Robertson (*Heat-Treat. and Forging*, 1937, 23, (2), 81-83).—Read before the Metals Treatment Society of Victoria. In a discussion concerning heat-treatment methods for ferrous metals, reference is made to the tendency of salt-baths containing nitrates to decompose at high temperatures and thus causing pitting of aluminium alloys immersed in them.—W. D. J.

Heating by the Oxy-Acetylene Process. — (Internat. Acet. Assoc., 1936, pp. 23).—The use of the oxy-acetylene flame is described for local hardening and annealing, heating for bending, heat-treating rail ends, stressrelieving, and brazing. Where the intense heat of oxy-acetylene is unnecessary, the air-acetylene flame is recommended.—H. W. G. H.

The Precipitation-Hardening of Aluminium [Alloy] Castings. (v. Zeerleder.) See p. 231.

The Effect of Heat-Treatment on Silumin Castings With and Without Magnesium. (Gurtler.) See p. 231.

\*Notes on the Hardness and Conductivity of Heat-Treated Copper Castings Alloyed with Zirconium and Beryllium. (Comstock and Bannon.) See p. 233.

## XVIII.-WORKING

#### (Continued from pp. 205-206.)

Rolling Mills for Research Work. — (Met. Ind. (Lond.), 1937, 50, (13), 391).—A brief description is given of three two-high, 8 in. diameter mills for rolling cold strip, hot strip, and rod, respectively, at the Osram Lamp Works, Wembley. These mills are used for rolling sintered bars of molybdenum and tungsten to sheet, as well as for rolling  $1\frac{1}{2}$  in. square ingots produced in a 30 lb. high-frequency furnace.—J. C. C.

high-frequency furnace.—J. C. C. Ultra-Fine Special-Alloy Wire Processed with Gas Fuel. R. H. Minton (Indust. Gas, 1937, 15, (9), 7-8, 22).—M. describes the drawing and annealing of wire of Monel metal, stainless steel, nickel, nickel-brass, phosphor-bronze, and alloys of nickel-chromium and silicon-manganese-nickel.—A. R. PE.

\*An X-Ray Study of Preferred Orientation in Rolled Copper. (Anderson and Kehl.) See p. 240.

\*The Preferred Orientation Produced in Pure Iron-Nickel Alloys by Cold-Rolling. (McLachlan and Davey.) See p. 241.

Forging Monel Metal, Nickel, and Inconel. F. P. Huston (*Heat Treat.* and Forging, 1936, 22, (10), 499-505; and Met. Ind. (Lond.), 1937, 50, (8), 231-234).—High-nickel alloys must be heated in slightly reducing, sulphurfree atmospheres, and shielded from contact with unburned fuel. If conditions are correct, a forged bar should show no cracking after being bent cold through 180°. Choice of fuels, and the correct time and temperature for heating are discussed, notes are given on steels for drop forging dies, and the mechanical properties of typical forgings tabulated.—J. C. C.

Manufacture of Nickel Coinage. Tsuguo Hirose (*Tetsu to Hagane (J. Iron Steel Inst. Japan)*, 1937, 23, (4), 360–362).—[In Japanese.]—S. G. Production of Ornamental Stampings. Nickel Silver Buttons and Badges.

Production of Ornamental Stampings. Nickel Silver Buttons and Badges. —— (Met. Ind. (Lond.), 1937, 50, (7), 211-217).—A brief illustrated account is given of the manufacture of buttons and badges from annealed nickelbrass blanks. A simple gravity drop stamp, foot operated through the medium of a rope and pulley, is employed.—J. C. C.

Metallic Powders and Dusts. V. P. Pavlov (Legkie Metalli (Light Metals), 1936, (11), 57-60).—[In Russian.] A description of the manufacture of aluminium powder.—D. N. S.

Lubrication in the Cold-Working of Metals. — (Met. Ind. (Lond.), 1937. 50, (13), 383-385).-Report of a discussion by the Midland Metallurgical Societies (Birmingham Local Section of the Institute of Metals, &c.), dealing with the choice of lubricants in pressing, rolling and drawing operations. J. C. C.

Soap and Soap Compounds for the Metal Industries. Benjamin Levitt (Chem. Industries, 1937, 40, (1), 57-58).—Recipes are given for soap-base lubricants for metal cutting, forming brass, wire drawing, burnishing, cleaning before plating, and finishing and polishing.-A. R. P.

## XIX.—CLEANING AND FINISHING

(Continued from pp. 207-208.)

Analyzing and Controlling Metal Cleaning Operations. T. W. Reese (Monthly Rev. Amer. Electroplaters' Soc., 1937, 24, (2), 83-94).—Practical hints for obtaining efficient cleaning in simple immersion and electrolytic cleaner outfits.-A. R. P.

Metal Cleaning. Principles and Practice.-II. C. B. F. Young (Abrasive and Cleaning Methods, 1937, 1, (7), 6-14).-Rattlers and various types of sand-blasting machines for cleaning castings are illustrated, and their construction is briefly described.—A. R. P. Heating the Solutions in Metal Cleaning Tanks. J. B. Nealey (Indust.

Finishing, 1937, 13, (5), 18-20, 22, 24).-Various types of gas-fired immersion heaters are described with reference to diagrammatic sketches. The tanks should preferably be heat-insulated since uninsulated tanks operated at 65° C. lose about 180 B.t.u. of heat/hr./ft.<sup>2</sup> of wall surface, about the same amount from the surface of the liquid by radiation and convection, and a variable amount by evaporation; a 3 in. lagging will reduce gas costs by about 35% on a tank  $7 \times 4 \times 31$  ft. For acid tanks, lead tube heaters with walls 1 in. thick are satisfactory.-A. R. P.

Some Practical Advice for Electroplaters in Cleaning Before Plating. André Darlay (Galvano, 1936, (53), 20-22; (54), 19-22; (55), 19-20; (56), 13-15; and Metal Cleaning and Finishing, 1937, 9, (2), 133-134, 142; (3), 227-228, 241).-A combined alkaline cyanide and coppering degreasing bath is recommended in place of the plain cyanide bath.-A. R. P.

Cleaning Before Plating. F. A. Maurer (Monthly Rev. Amer. Electroplaters' Soc., 1937, 24, (4), 268-277; discussion, 277-279; and (abridged) Met. Ind. (Lond.), 1937, 50, (23), 633-635).-A brief review of the function and merits of various types of cleaners.-A. R. P.

A Chemical Study of Alkaline Cyanide Degreasing and Coppering Baths. A. Chaybany (1st Internat. Electrodeposition Conf. (London), Advance Copy, 1937, 8 pp.; and Aluminium and Non-Ferrous Rev., 1937, 2, (5), 197-198, 200).—From experiments made with a degreasing and coppering bath con-taining sodium cyanide 50, caustic soda 80, and cuprous cyanide 5 grm./ litre it appears that deterioration of this type of bath may be due to contamination with zinc or to oxidation of part of the cyanide to cyanate. Zinc may be removed by adding sodium sulphide and cyanate reduced by using copper instead of steel anodes or by adding sodium hydrosulphite to the bath. The anodes should be kept continuously immersed in the bath and the operating current density should not exceed 4-5 amp./dm.<sup>2</sup>.-A. R. P.

Essentials of Good Pickling Practice [-1]. P. R. Russell (Metal Cleaning and Finishing, 1937, 9, (2), 113-116, 153).—Practical hints are given on pickling ferrous metals to produce a good surface for plating, &c.—A. R. P. Pickling Nickel Silver. P. Mabb (Machinist (Eur. Edn.), 1937, 81, (13),

206E).-The use of local annealing of nickel-brass is dealt with, and the

Pickling Plant of Greater Durability. —— (Beizerei (Suppt. to Emaillewaren-Ind.), 1936, 1, (Oct. 29), 13-15).—The resistance to corrosion of Monel metal is discussed.—S. G.

\*Thermal Properties of Alumilite Coatings. R. E. Pettit (Alcoa Digest, 1936, Sept. 14; Light Metals Rev., 1936, 31, (7), 145-147; Light Metals Research, 1936, 5, (8), 189-191; and Aluminium and Non-Ferrous Rev., 1936, 2, (3), 122).—The emissivity of plain and dyed oxide films prepared on aluminium by the Alumilite process has been determined. Emissivity is increased by the oxide coatings, rising from 6% for oxide-free metal to 82% for metal having an oxide film 0.00040 in. thick. Dyes increase emissivity. Infra-red reflectivity is decreased as the emissivity increases.—J. C. C.

Developments in the Application of Organic Metal Finishes. E. A. Zahn (*Metal Cleaning and Finishing*, 1937, 9, (1), 41-44, 49).—Discusses : dipping and cleaning methods, filters for dripping tanks, paint control, drying, flow-coating, spraying, roll-coating, and centrifugal painting.—A. R. P.

Metal Colouring with Molybdate Solutions. H. Krause (Metallwaren-Ind. u. Galvano-Tech., 1937, 35, (2), 43-44).—A solution containing ammonium molybdate 20 and nickel sulphate 50 grm./litre colours zine black in 15 minutes and aluminium dull black in 30 minutes on boiling. Hot solutions of ammonium molybdate and fluoride colour zine a light yellow-brown and zine-base die-castings a brownish black. Various other shades of brown can be obtained by addition of potassium permanganate, zine sulphate, copper sulphate, sodium acetate, or various chlorides.—A. R. P.

Guard Value of Aluminium by Careful Finishing. L. R. Eastman (Abrasives, Grinding, Polishing, 1937, 18, (2), 12–14, 64).—Practical hints are given for polishing and finishing sand- and permanent-mould castings of aluminium.

-A. R. P.

Abrasives for Metal Polishing.—I. Cyril S. Kimball (Metal Cleaning and Finishing, 1937, 9, (2), 147–153).—Describes the properties and uses in polishing processes of carborundum, fused alumina, corundum, emery, garnet, quartz, felspar, pumice, silica, tripoli, and rottenstone.—A. R. P.

When and Where Exhaust Systems Are Practical. M. I. Dorfan (*Abrasive and Cleaning Methods*, 1937, 1, (7), 20–22).—The importance of a correctly designed dust-collecting system in certain industrial operations is stressed; several examples of its value in safeguarding the health of the operatives are cited.—A. R. P.

## XX.—JOINING

#### (Continued from pp. 208-210.)

The Riveting of Aluminium and Its Alloys, Especially Avional and Anticorodal. E. von Burg (*Schweiz. Tech. Zeit.*, 1936, (40), 627-633).—Standard shapes and dimensions of Avional and Anticorodal rivets are given, and the correct methods of using the rivets are described. Formulæ are also given for calculating the best size of rivet for use with sheet of any thickness.—A. R. P.

Some Soft Soldering Problems. Specification and Choice of Solders. C. C. Miller (*Met. Ind.* (*Lond.*), 1937, 50, (10), 295–297; and *Tin*, 1937, (Apr.), 17–19).—The advantages of purchasing solder to a definite composition are emphasized. For bit soldering of copper alloys, antimonial 50% tin solder is recommended, but for electrical joints, where fluidity is important, the eutectic 64% tin alloy is advantageous. A pure, antimony-free 50% tin alloy is suitable for machine soldering of tinplate, but a cheap 40% tin antimonial solder is effective for hand

soldering, where speed of working is of less importance. Non-antimonial solder should be used for galvanized sheet. Trouble with plumbers' solder for wiping joints in lead pipe is frequently due to variations in the thickness of stick supplied.—J. C. C. Cored Solders. Their Manufacture and Applications. C. C. Miller (Met.

Cored Solders. Their Manufacture and Applications. C. C. Miller (Met. Ind. (Lond.), 1937, 50, (13), 379-382).—Cored solders are preferably made from non-antimonial alloys, and contain  $2-3\frac{1}{2}$ % of flux, which may be corrosive (zinc chloride in ethylene glycol, glycerine, gum tragacanth, or petroleum jelly) or non-corrosive (resin or, under certain conditions, aniline hydrochloride or orthophosphoric acid). The solder is usually extruded as  $\frac{1}{4}$ -in. diameter wire in a horizontal press, having a gas-heated container kept at  $140^\circ$ -150° C. and a water-cooled die. The flux is introduced by gravity or pressure through a hollow mandril. The extruded material is finally drawn down to the required gauge.—J. C. C.

Soldering and Brazing. Oscar D. Rickly (Eng. Exper. Sta. News, Ohio State Univ., 1936, 8, (3), 21-23).—Brief notes on the composition and application of solders and fluxes for joining copper and copper alloys, lead, galvanized iron, tinned iron, zinc, and aluminium.—A. R. P.

Silver Alloys as Brazing Materials for Spuds in Tank Construction. H. A. Folgner (Metals and Alloys, 1937, 8, (1), 29-32).—The most suitable brazing alloys for inserting spuds in metal tanks are (a) silver 15, copper 80, phosphorus 5% and (b) silver 50, copper 15.5, zinc 16.5, cadmium 18%; the first melts at about 640° C. and is fluid at 705° C. while the second melts around 630° C. A perforated disc of the alloy is placed round the hole in the tank, the spud set in position with a simple jig, the joint covered with a boric acid-potassium fluoride flux and the brazing effected by heating the metal round the joint with an oxy-acetylene torch. The resulting joint is extremely strong and has a good resistance to corrosion.—A. R. P.

Furnace Brazed Joints and How to Design Them. B. W. Gonser (*Machinist* (*Eur. Edn.*), 1937, 81, (9), 140–143E).—Describes the equipment and gives details of the process for brazing joints with a controlled-atmosphere furnace requiring no brazing rod, are, or torch.—J. H. W.

requiring no brazing rod, arc, or torch.—J. H. W.
Brazing Defective Steel Castings. A. Eyles (Machinist (Eur. Edn.), 1937, 81, (1), 13E).—A letter. Describes the brazing of steel castings with the alloys:
(1) copper 64.4, zinc 33.6% at 918° C.;
(2) copper 63, zinc 37% at 908° C.;
(3) copper 60, zinc 40% at 890° C.—J. H. W.

Aluminium Joining in Electric Technology. W. Büngner and W. Hammerschmidt (*Aluminium*, 1937, 19, (2), 86–88).—Methods of joining aluminium cables to one another, to special sockets for clamping in insulators, and to copper or brass shoes without the use of a flux are described, with reference to illustrations showing the construction and arrangement of the necessary jigs and the method of applying the torch.—A. R. P.

Welding of Light Wrought Alloys [Silumin, K.S.-Seewasser, and Elektron]. C. Auchter (Aluminium-Archiv, 1936, 4, 19 pp.; Bull. B.N.F.M.R.A., 1937, (97)).—An investigation of methods of welding and of properties of welded joints in sheets of 4 mm. thickness.—S. G.

Spot-Welding Aluminium. A. E. Peters (*Machinist* (*Eur. Edn.*), 1937, 81, (10), 161E).—A brief note. Aluminium can be spot-welded successfully on a production scale if proper allowance is made in the resistance welding equipment for its particular properties. One of the special copper-base hard alloys should be used for the electrodes, which should have shaped ends and be water-cooled. About four welds to the inch can be made where necessary.

-J. H. W.

Spot- and Roll-Welding of Light Metals. F. Rosenberg (Aluminium, 1937, 19, (2), 89–97).—Modern types of spot-welding and roll-welding machines are described and details are given of the operating conditions for joining various light metal alloys. Microstructures of welds are illustrated and the properties of the welded joints discussed.—A. R. P.

The Resistance Welding of Light Alloys. Henri Portier (*Pratique Indust. mécan.*, 1937, 20, (1), 3-10).—A survey is given of welding methods, and in particular of the resistance welding of aluminium and the light alloys, the exceptional thermal and chemical properties of which necessitate modifications in practice. An extensive *bibliography* is given.—P. M. C. R.

Fleetwings Welds All-Metal Planes. Fred. H. Colvin (*Machinist (Eur. Edn.*), 1937, 81, (9), 205-206).—Briefly describes the "Shotweld" method of joining stainless steel in a large American aeroplane factory, and an inexpensive forming press for light metal shapes.—J. H. W.

Welding Castings. W. Holmes (Motor Transport, 1937, 64, (1677), 8, 21).—A brief article giving practical hints on the repair of fractures in aluminium and in cast and malleable iron.—L. A. O.

Oxy-Acetylene Welding of Copper-Silicon Alloys. I. T. Hook (Industry and Welding, 1937, 10, (1), 61-63; C. Abs., 1937, 31, 2156).—These alloys have good weldability owing to their low thermal conductivity, good hot ductility (except in the narrow range below the melting point), and the formation of an adherent flux film which protects the molten weld metal. Oxides of manganese, zine, or tin are of additional benefit for good fluxing. The welding procedure is practically the same as for cupro-nickels.—S. G.

\*Electric Welding of Nickel and Monel Metal. Tsuyoshi Okamoto, Hideo Nishimura, and Iwao Onishi (*Yosetsu Kyokaishi (J. Weld. Soc. Japan*), 1936, 6, (8), 431-437).—[In Japanese.] Describes tests on the arc and resistance welding of nickel and Monel metal.—S. G.

\*Effects of Oxygen in Electric Arc Welding of Nickel and Its Alloys. Tsuyoshi Okamoto, Hideo Nishimura, and Hiroshi Katayama (Yosetsu Kyokaishi (J. Weld. Soc. Japan), 1936, 6, (9), 481-486).—[In Japanese.] The mechanical properties of the deposited beads are generally inferior to those of the base metal, partly owing to increase of the oxygen content.—S. G.

Welding Dissimilar Metals. F. G. Flocke and J. G. Schoener (*Industry* and Welding, 1937, 10, (1), 64–67; C. Abs., 1937, 31, 2157).—For welding nickel to iron ( $\frac{1}{10}$  in. and over) the scarfed edge of the iron is first overlaid with a layer of nickel deposited on the plate by fusion welding and then the weld is made to the nickel plate. The welding of Monel metal to iron is described.—S. G.

\*The Effect of Original Grain-Size of Molybdenum Powders on the Properties of Welded Metal. N. A. Agarkova and A. M. Korolkov (*Metallurg (Metallurgist*), 1936, (12), 116-119).—[In Russian.] The rate of grain growth in molybdenum in welding depends on the original grain-size of the metal powder, the finer is the grain thereof the larger are the crystals that are formed at constant welding temperature.—N. A.

Non-Ferrous Welding. Choice of Method and Control of Welds. H. W. G. Hignett (*Met. Ind.* (*Lond.*), 1937, 50, (9), 275–278; discussion, (10), 299– 300; and (summary) *Metallurgia*, 1937, 15, (89), 146).—Read before the Midland Metallurgical Societies (Birmingham Local Section of the Institute of Metals, &c.). The characteristics of the processes of oxy-coal-gas, oxy-hydrogen, oxy-acetylene, carbon and metallic arc, atomic hydrogen, and electric resistance spot, seam, butt, and flash welding are described, and their applications for the welding of non-ferrous metals reviewed. The need for accurate flame control in gas welding is emphasized. Notes are given on the control and testing of welds, the examination of raw materials, and the training of welders.—J. C. C.

Electric Welding of Non-Ferrous Metals and Alloys. Iwao Onishi (Kikai Kogaku (Mech. Eng.), 1936, 4, (9), 2–7).—[In Japanese.]—S. G.

\*Stress Distribution in Irregular Sections Using Photo-Elastic Models. T. U. Matthew (J. Royal Tech. Coll., 1937, 4, (Part 1), 121-134).—Describes an investigation of the distribution of two-dimensional stress in welded joints and other sections containing irregularities. The results were obtained using celluloid models with photo-elastic properties. The dangerous effect of irregularities in a stressed section in forming points of high stress concentration, especially where sharp changes of slope occur, is demonstrated, as is also the necessity for complete penetration. If a full development of the joint strength is to be obtained, adequate fillets or flush finishing in welded joints is shown to be essential.—J. W. D.

Design of Jigs for Oxy-Acetylene Welding. — (Internat. Acetylene Assoc., 1936, 31 pp.).—The fundamentals of jig design are discussed, particularly with regard to economie working on mass production, repairs, or odd jobs. Constructional details and clamping devices of different kinds are described.—H. W. G. H.

## XXI.—INDUSTRIAL USES AND APPLICATIONS

#### (Continued from pp. 210-215.)

Aluminium Busbars. C. H. Ridpath (Assoc. Supervising Elect. Eng. Advance Copy (Typescript), 1936, (Dec.), 19 pp.; Bull. B.N.F.M.R.A., 1937, (94)).—Particular reference is made to the use of bare aluminium busbar instead of insulated cable for vertical main feeders running up buildings in a small fireproof duct.—S. G.

**R.R. 56.** Aluminium Alloy Tubes, Sections, and Sheets. — (Bur. Information Nickel, 1936, (D8), 15 pp.).—The physical and mechanical properties of R.R. 56 at various temperatures, after various heat-treatments and in the form of tubes and sheets are discussed. The applications of this alloy are considered.—W. D. J.

Use of Light Alloys in Modern Technology. P. A. Neznamov (Legkie Metalli (Light Metals), 1936, (11), 39-45).-[In Russian.] A detailed review. -D. N. S.

<sup>†</sup>Copper and Its Alloys in Automobile Design. D. P. C. Neave (*Met. Ind.* (*Lond.*), 1937, **50**, (9), 267–273).—Slightly abridged from a paper read at a joint meeting of the Scottish Sections of the Institute of Metals and Institution of Automobile Engineers. Present practice in the use of copper and its alloys in automobile engineering is reviewed, attention being given to phosphor bronze, oil-bearing moulded bronze, wrought bronze, beryllium bronze, and copper-lead bearings. Age-hardened alloys of copper with 0.4-0.5% chromium have been used for cast cylinder heads, their use resulting in greater developed horse-power with lower petrol consumption. Copper inserts in cast-iron heads, heads of aluminium bronze, and cast-iron heads plated on the inside with copper have also been used with good results. The easting, heat-treatment, and application of chromium—copper heads are described.

-J. C. C.

Tentative Specifications for Gate Valves for Ordinary Water Works Service. —— (J. Amer. Water Works Assoc., 1937, 29, (3), 408–423).—Specifications for mechanical properties of bronzes to be used in the manufacture of various gate valve parts. Reference is made to gates, gate and body rings, wedging devices, guides, rollers and tracks for horizontal valves, and stem and stem nuts.—W. D. J.

Graphitized Babbitt. M. Drits (Novosti Tekhniki (Tech. News): Seriya Gorno-Rudnaya Promishlennost, 1936, (29-30), 23; C. Abs., 1937, 31, 2152).— [In Russian.] A Babbitt having high anti-friction properties contains lead 73:44-71:50, antimony 14:60-16:24, tin 10:47-10:22, copper 1:30-1:40, and carbon 0:19-0:26%.—S. G.

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Gas Immersion Heating. J. B. Nealey (Amer. Gas J., 1937, 146, (2), 22–24).—Lead immersion pipes are used for gas heating of acid tanks for pickling, electroplating, &c.—A. R. PE.

Low-Cost Production of Soft Metal Tube Containers. J. B. Nealey (Indust. Gas, 1937, 15, (8), 7-8).—Plant for mass-production of lead or tin collapsible containers and caps is described.—A. R. PE.

On the Production and Use of Magnesium Alloys. A. S. Lugaskov (Legkie Metalli (Light Metals), 1936, (11), 35-38).—[In Russian.] A review.—D. N. S. †Application of Nickel Alloys in Water Power Plants. Saiichiro Uchimaru

<sup>†</sup>Application of Nickel Alloys in Water Power Plants. Salichiro Uchimaru (*Japan Nickel Rev.*, 1937, 5, (1), 4–27).—[In English and Japanese.] Stainless steel and various grades of nickel alloy steel are used in Japan for most of the parts of water-power plants which are subject to corrosive and erosive conditions; valves and nozzles which adjust the water jets of Pelton wheels are, however, made of Monel metal.—A. R. P.

**†Nickel Alloys in Steam Power Plants.** Shigemitsu Niwa (Japan Nickel Rev., 1937, 5, (1), 28-66).—[In English and Japanese.] Various types of Monel metal valves for superheated steam service are illustrated and described, and the mechanical properties of Monel metal in various forms are tabulated. Ball floats and baffles as well as certain parts of "Electrofio" meters, steam traps, and strainers are also made of Monel metal. A nickel-copper alloy containing nickel 9-12, aluminium 1-3, and zine 0.5-3% and "N.M. Bronze" containing (best composition in brackets) nickel 6-28 (12), zine 30-42 (38), iron 1-3 (3), aluminium 0.25-1 (0.5), and manganese 0.5-1 (0.5)% have been found excellent for making turbine blades; the "N.M. Bronze" retains a remade of a 70 : 30 cupro-nickel alloy which is highly resistant to corrosion and not subject to season-cracking.—A. R. P.

Monel Metal in the Petroleum Industry. Rudolf Müller (Oel u. Kohle, 1937, 13, (14), 325-329).—The suitability of several types of Monel metal for a variety of oil-refinery fittings is illustrated by a series of tabulated comparisons of the mechanical properties of these materials at ordinary and low temperatures, and of their resistance to corrosive attack by petroleum, zine chloride, and phenol with the corresponding properties of phosphor bronze, Inconel, and certain steels.—P. M. C. R.

Nickel-Copper Alloys for Slip Rings. — (Nickel Bull., 1937, 10, (2), 25–27).—Describes the properties which render 90:10 and 96:4 coppernickel alloys suitable for slip rings.—J. H. W.

Nickel as a Catalyst. O. B. J. Fraser (*Electrochem. Soc. Preprint*, 1937, (April), 397-457).—A summary is given (with 471 *references*) of the very considerable amount of technical and patent literature on the preparation and use of nickel, its compounds, and some of its alloys as catalysts.—S. G.

[Sodium in] Aero-Engine Valve Manufacture. —— (Machinery (Lond.), 1937, 50, (1280), 93-97).—Contains a brief illustrated account of the methods used in filling hollow valves of the Napier "Dagger" engine with metallic sodium. Extruded lengths of sodium are pressed into the valve stems, which are previously heated to 300° F. in a bath of molten lead.—J. C. C.

The Use of Tin in Refrigerating Equipment. E. J. Daniels and D. J. Macnaughtan (*Proc. Brit. Assoc. Refrig.*, 1936–1937, 33, (1), 78–86; and *Tech. Publ. Internat. Tin Res. Develop. Council, Series B*, 1937, (3), 8 pp.).— Brief details are given of coating copper with tin by hot-dipping, wiping, electrodeposition, and spraying. The tinning of copper pipes is particularly mentioned. The applications of tinned copper to milk coolers, beer chilling, soda water cooling, ice cream containers, and refrigerators are described. The occurrence of tin pest in tinned-copper refrigerating equipment is regarded as unlikely. Under corrosive conditions and where lead contamination is possible, pure tin or tin containing small amounts of antimony are preferable to normal solders.—W. D. J.

Alloys for Bearings. T. V. Vereshchagin (Novosti Tekhniki (Tech. News): Seriya Gorno-Rudnaya Promishlennost, 1936, (23), 4-5; C. Abs., 1937, 31, 2149).—[In Russian.] An alloy for bearings which gave quite satisfactory results had the composition: zinc 81.75, copper 11.94, aluminium 4.96, silicon 0.42, iron 0.14, and lead 1.02%.—S. G.

Bi-Metallic Strip and Its Applications. — (Nickel Bull., 1936, 9, (10), 209–213).—Describes the composition and characteristics of bi-metallic strip for a number of different applications.—J. H. W.

The Application of Materials to Gasworks Construction. H. Johnston (Gas World, 1937, 106, (2752), 429-433).—The merits of asbestos sheets fixed with copper nails and of galvanized iron as building materials are discussed. Machinery can be protected against corrosion by electrochemical deposition of nickel, chromium, cadmium, copper, and lead, and worn parts can similarly be built up to original dimensions without danger of distortion.

-A. R. PE.

\*[Effect of Metals on the] Rancidity of Butteriat [Ghee]. N. N. Godbole and —— Sadgopol (Z. Untersuch. Lebensm., 1936, 72, 35-45; C. Abs., 1937, 31, 1896).—East Indian buffalo butterfat (ghee) was exposed to conditions producing rancidity, which conditions were standardized. Among other factors, the influence of metals on the formation of rancidity in fresh ghee was studied.—S. G.

## XXII.-MISCELLANEOUS

(Continued from p. 215.)

Metallurgical Progress in the Australian Commonwealth. J. Neill Greenwood (*Proc. Australasian Inst. Min. Met.*, 1936, (103), 209–235).—Presidential Address. Present practice at Australian gold, zinc, lead, and copper mines is briefly reviewed.—A. R. P.

The Aluminium Industry in 1937. E. A. Yampolski (Legkie Metalli (Light Metals), 1936, (10), 3-6).—[In Russian.] A survey of the aluminium works of the U.S.S.R. in 1936. The problems before the works, in connection with the 89% increase in aluminium production in 1937 as compared with last year, are discussed.—D. N. S.

Nomenclature of Copper Alloys. Brass and Bronze. — (U.S. Bur. Stand. Letter Circular 487, 1937, 4 pp.).—An explanation of the significance of the many terms loosely applied commercially to various brasses and bronzes.—W. D. J.

Chemical Examination of Prehistoric Bronzes of Sardinia. F. L. Vodret (Atti V. Congr. naz. Chim., 1936, 105-120).—A review.—S. G.

Goldsmiths' Practice in the Schedula of Theophilus. Wilhelm Theobald (Tech. Studies Field Fine Arts, 1937, 5, (3), 139–149).—A detailed account is given of the methods used by the goldsmiths and silversmiths of the Middle Ages in the manufacture of gold and silver chalices.—A. R. P.

\*Equilibrium in Lead Smelting. S. Frederick Ravitz and Kenneth E. Fisher (*Trans. Amer. Inst. Min. Met. Eng.*, 1936, 121, 118-122; discussion, 122-126).—The distribution of gold and silver between slag, matte, spciss, and lead bullion from the blast furnace has been determined. For gold the average distribution ratio is 0.006:0.0726:1.652:1.000 and for silver 0.003:0.562:1.200:1.000.—A. R. P.

Control of Dust and Fumes. H. B. Meller (Safety Eng., 1936, 72, 195–196, 198; C. Abs., 1937, 31, 2312).—Dusts that are inherently toxic or absorbed and cause systemic poisoning include lead, arsenic, mercury, and manganese. —S. G.

Pitfalls in the Rocky Road of Research. C. F. Kettering (Ohio State Univ. Indust. Research Conf. Pamphlet, 1936, (Nov.), 16 pp.).—An address. [The author is Director of Research of General Motors Corpn.]—S. G.

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- \*Minerais et Métaux. Renseignements statistiques concernant les Métaux Cuivre, Plomb, Zinc, Etain, Aluminium, Argent, Or. Années 1913, 1927 à 1936. 4to. Pp. 103, with folding plate. 1937. Paris: Minerais et Métaux, 55 Rue d'Amsterdam.
- \*Newitt, D. M. Edited by. Chemical Industries. A Compilation of Data and Information Essential to the Conduct of all Process Industries. 4to. Pp. 374 + lxxix. 1937. London: Leonard Hill, Ltd., 17 Stratford Place, W.1. (10s.)
- \*Nyrop, J. E. The Catalytic Action of Surfaces. Second Edition. Cr. 4to. Pp. 103, illustrated. 1937. Copenhagen: Levin & Munksgaard; London: Williams and Norgate, Ltd. (7s.)
- \*Oelsen, Willy, und Gottfried Kremer. Das Verhalten der Schmelzen von Eisen, Nickel und Mangan gegen ihre flüssigen Silikate und feste Kieselsäure bei 1600°. (Mitteilungen aus dem Kaiser-Wilhelm-Institut für Eisenforschung zu Düsseldorf. Herausgegeben von Friedrich Körber. Band XVIII, Lieferung 8.) 21 × 29.5 cm. Pp. 89-108, with 25 illustrations. 1936. Düsseldorf: Verlag Stahleisen m.b.H. (R.M. 3.75.)

- \*Pehrson, Elmer. Zinc. (U.S. Department of the Interior, Bureau of Mines. Minerals Yearbook, 1936, Part II.) Med. 8vo. Pp. 157-179. 1936. Washington, D.C.: Superintendent of Documents. (5 cents.)
- \*Pehrson, Elmer W., and H. M. Meyer. Lead. (U.S. Department of the Interior, Burcau of Mines. Minerals Yearbook, 1936, Part II.) Med. 8vo. Pp. 137-156. 1936. Washington, D.C.: Superintendent of Documents. (5 cents.)
- \*Portevin, Albert, et Paul Bastien. Réactifs d'attaque métallographique. Notions générales et formulaire relatifs aux réactifs micrographiques et macrographiques. 13 × 21 cm. Pp. xviii + 267, with 16 illustrations. 1937. Paris : Dunod. (Relié, 102.25 francs; broché, 87.25 francs.)
- \*Ridgway, Robert H. Chromite. (U.S. Department of the Interior, Burcau of Mines. Minerals Yearbook, 1936, Part II.) Med. 8vo. Pp. 475-486. 1936. Washington, D.C.: Superintendent of Documents. (5 cents.)
- \*Ridgway, Robert H. Manganese and Manganiferous Ores. (U.S. Department of the Interior, Burcau of Mines. Minerals Yearbook, 1936, Part II.) Med. 8vo. Pp. 425-441. 1936. Washington, D.C.: Superintendent of Documents. (5 cents.)
- \*Ridgway, Robert H., and J. B. Umhau. Tungsten. (U.S. Department of the Interior, Bureau of Mines. Minerals Ycarbook, 1936, Part II.) Med. 8vo. Pp. 447-455. 1936. Washington, D.C.: Superintendent of Documents. (5 cents.)
- \*Shore, F. M., and H. M. Meyer. Antimony. (U.S. Department of the Interior, Bureau of Mines. Minerals Ycarbook, 1936, Part II.) Med. 8vo. Pp. 487-494. 1936. Washington, D.C.: Superintendent of Documents. (5 cents.)
- \*van Siclen, A. P., and C. N. Gerry. Arsenic. (U.S. Department of the Interior, Burcau of Mines. Minerals Yearbook, 1936, Part II.) Med. 8vo. Pp. 495-500. 1936. Washington, D.C.: Superintendent of Documents. (5 cents.)
- \*Smithells, Colin J. Gases and Metals. An Introduction to the Study of Gas-Metal Equilibria. Demy 8vo. Pp. vii + 218, with 145 illustrations. 1937. London: Chapman and Hall, Ltd. (18s. net.)
- \*Tanzer, Gerhard. Die Palladium-Silber-Edelmetall-Legierungen. (Durchgeschen und begutachtet von der Fachwissenschaftlichen Arbeitsgemeinschaft des Reichsverbandes Deutscher Dentisten.) 15 × 21 cm. Pp. 64, with 32 illustrations. 1937. Dresden (A 16): Hermann Püschel. (M. 4.)
- \*Tin Producers' Association. Tin. World Statistics, 1937. Ninth Year. Post 8vo. Pp. 160. 1937. London: The Association, 11 Ironmonger Lane, E.C.2. (2s. 6d. post free.)

[After a few charts covering prices, production, consumption, U.K. and U.S.A. motor vehicle output and tinplate production, very complete statistics are given for prices; production, consumption, and stocks; world production and consumption; supplies; deliveries; stocks, and miscellaneous. The last 48 pages give detailed statistics for the consuming industries.]

- \*Tyler, Paul M., and A. P. van Siclen. Minor Metals : Beryllium, Bismuth, Cadmium, Cobalt, Selenium, Tantalum, and Columbium, Tellurium, Titanium, and Zirconium. (U.S. Department of the Interior, Bureau of Mines. Minerals Yearbook, 1936, Part II.) Med. 8vo. Pp. 525-541. 1936. Washington, D.C.: Superintendent of Documents. (5 cents.)
- Ward, A. F. H. Applied Chemistry for Engineers. Pp. 138. 1937. New York: Longmans. (\$1.75.)

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\*Wever, Franz, und Heinrich Lange. Über den Ablauf der Umwandlungen bei den irreversiblen Eisen-Nickel-Legierungen. (Mitteilungen aus dem Kaiser-Wilhelm-Institut für Eisenforschung zu Düsseldorf. Herausgegeben von Friedrich Körber. Band XVIII, Lieferung 15.) 21 × 29.5 cm. Pp. 217-225, with 17 illustrations. 1936. Düsseldorf: Verlag Stahleisen m.b.H. (R.M. 2.) [See Met. Abs., this vol., p. 234.]

\*Wieland, M. Anleitung zur Bestimmung der Belichtungszeit für die mikrophotographische Aufnahme mit dem lichtelektrischen Belichtungsmesser. 15 × 21 cm. Pp. 50. 1936. Wetzlar: Scharfes Druckereien K.G. (R.M. 1.80.)

## XXIV.—BOOK REVIEWS

#### (Continued from p. 224.)

The Metallurgy of Gold. By (Sir) Thomas Kirke Rose and W. A. C. Newman. Seventh Edition, Revised Throughout and Reset. Med. 8vo. Pp. xiii + 561, with frontispiece and 238 illustrations. 1937. London: Charles Griffin and Co., Ltd. (36s. net.)

"How often is it that a reviewer can genuinely thank heaven that he has been given a particular book to review? Probably amid the daily round, the common toil, not so often." This is a quotation from a review which appeared in one of our well-known literary journals only a few days ago and I feel that these words are peculiarly appropriate on this occasion.

Nearly 50 years ago, Sir Thomas, myself, and four others competed for a position in the Royal Mint. Sir Thomas came out top and got the job, and I rather imagine that I was second on the list for subsequently I was offered a similar position in an Empire Mint, which, however, I could not accept, having entered on another avocation. Mr. Newman has also been known to me for many years and I would therefore like to say straight away that, knowing the authors as I do, I could commend any published work of theirs.

It is difficult to realise that 20 years have passed since the last edition was issued-Sir Thomas on that occasion being the sole author-for one finds the book wherever gold is dealt with. This new edition could not have been issued at a more appropriate time. Apart from the increase in the importance of the industry since the publication of the last edition, revolutionary changes have taken place in practically all of the processes which can be classed revolutionary enanges have taken place in place in place and on the place in the permanence have been under the heading of "treatment," and all which have any claim to permanence have been noted by the authors. Twenty years ago most of us thought that, in respect of treatment, finality had almost been reached, but a perusal of Chapters VIII "Intermediate and Fine Grinding" and X "Flotation" make it appear as if finality is as far off as ever. I think that Chapters XV and XVI are two of the most important in the book. The

former deals with special application of the cyanide process and the latter gives examples of typical metallurgical flow sheets collected from all parts of the world. In my opinion " flotation " with or without subsequent cyaniding may become a more important factor even on the Rand as time goes on, but the cyanide process, on account of its simplicity and cheapness of operation, will hold its own in the main for bulk ore treatment.

In the preface the authors state that they have produced "practically a new book "; this is perfectly true. It is an invaluable work of reference and no one connected directly or indirectly with gold can well do without it. The text alone runs to 540 pages of close printing and the information is both encyclopædic and dependable. The plates and illustrations are all good and, generally speaking, the publishers are to be congratulated on a very fine production. Unless I am very much mistaken, the present edition will soon be exhausted.

-W. CULLEN.

# Hardness of Metals. By F. C. Lea. Med. 8vo. Pp. vi + 141, with 81 illustrations. 1936. London: Charles Griffin and Co., Ltd. (12s. 6d.)

In this little book Professor Lea gives the reader a somewhat heterogeneous collection of information concerning hardness and hardness testing, the value of which it is somewhat difficult to assess. In brief, the book consists largely of descriptions of and comments on the usual methods for hardness testing of metals together with detailed results of tests made in various machines in use in the author's laboratory. The numerous results are worth placing on record, and the reader in search of detailed information on variations and inconsistencies in hardness testing is advised to consult them. He will glean much information of interest, and if he is interested in steels (with which the book is very largely concerned) may find exactly

the results which solve his particular problem. The average reader who is looking for general conclusions, however, may be disappointed. Many detailed results are given, but the author is inclined to leave the reader to reach his own conclusions from these results. One feels that Professor Lea from his experience and knowledge of the subject would have been more helpful had he expressed more of his own opinions and conclusions, and perhaps omitted some of the detail associated with the Tables.-G. A. HANKINS.

Korrosion und Dauerfestigkeit. Von A. Thum und H. Ochs. (Mitteilungen der Materialprüfungsanstalt an der Technischen Hochschule, Darmstadt, Herausgegeben von A. Thum. Heft 9.)  $15 \times 22$  cm. Pp. vi + 109, with 65 illustrations. 1937. Berlin: V.D.I.-Verlag G.m.b.H. (Br., R.M. 9; V.D.I.-Mitgl., R.M. 8.10.)

The value of metals for constructional purposes is commonly assessed by laboratory tests such as the determination of elastic limits, breaking stress, behaviour under alternating stresses. &c. These determinations are certainly of considerable use, but it is nowadays being more and more realized that laboratory tests can only very roughly take into account influences to which the completed structure may be subjected. Of these corrosion is by far the most important. In this little booklet the authors review knowledge relating to the corrosion of constructional metals and alloys, and direct attention to the necessity for taking into account corrosion as a factor controlling the durability of structures. Fracture is conditioned to a greater extent by corrosion than by any other single factor. The state of affairs is not appreciably improved by any of the usual processes, e.g. heat-treatment or cold-working to which the materials may be subjected. Methods of preventing corrosion by electrolytic protection. by metallic and non-metallic coatings, by the nitrating processes, &c., are briefly reviewed, and finally the recently-introduced process whereby corrosion is reduced by the production of suitable internal eigen-stresses within the materials is commended. [Parenthetically it may be remarked that the word "eigen" has been absorbed into English mathematics with the approximate meaning of characteristic or intrinsic.] This method, which we may call the eigen-stress method, seems promising, and has much to commend it. Presumably the rationale of the protection afforded is associated with the tendency of the eigen-stresses to oppose those forces tending to open superficial knicks in the material. Finally it is interesting to note that the process of protection is based on work done by Gough and Sopwith, some of which has been published in the Journal of the Institute of Metals.

This booklet can be heartily commended to anyone interested in metallic constructional work.-J. S. G. THOMAS.

Das Wichtigste vom Korrosionsschutz. Ein Merkbüchlein für Baufachleute und alle an der Sachwerterhaltung interessierten Kreise. Von Hans Hebberling.  $12 \times 20$  cm. Pp. 45, with 18 illustrations. 1936. München: Geo. Callwey. (M. 2.)

This booklet is intended to present to the practical man the essential principles of protection against corrosion of the important structural materials, steel, wood, and concrete. The purpose is admirably served, the measures recommended being based on the experience of the German railways and the results of tests carried out at their central laboratory. Painting is shown to be by far the most economic method of protecting iron and steel, and the virtues of red lead as an inhibitive agent are pointed out. The importance of long-time testing of protective coatings is emphasized, and the German standard scale of "degree of rusting" is explained.

The use of Gothic print does not assist the English reader, but with excellent printing gives the booklet a most attractive appearance. The reference, on p. 41, to Fig. 15, should be to Fig. 16.—H. W. G. HIGNETT.

Vorschriften zur Metallbewirtschaftung. Eine Zusammenfassung mit Erlauterungen. Von Gunther Brandt.  $18 \times 21$  cm. (Loose Leaf). 2. völlig neubearbeitete und erheblich erweiterte Auflage. 1936. Berlin : N.E.M. Verlag. (R.M. 16.)

This is a compilation of orders governing the use of metals in Germany, and embraces statements of the authority vested in the appropriate Ministers and also schedules showing the limitations which are to be put on the manufacture of metallic goods other than armaments. In the ten main sections into which the book is divided the enactments which govern the uses of ores, by-products, semi- and fully manufactured articles and their export and import are set out, together with regulations as to the fixing of prices. Explanatory notes follow the texts of the orders.

To those most particularly interested it must be useful to have these regulations in a handy form.-W. A. C. NEWMAN.

#### Der Leichtmetall-Schweisser. Von Hermann Holler. 15 × 21 cm. Pp. 102, with 92 illustrations. 1936. Halle a. S.: Carl Marhold. (R.M. 2.)

The first section of this little book is devoted to the properties of aluminium, the technique necessary for welding, and the properties of the welds. The oxy-acctylene process is recommended, hammer-welding being regarded as suitable only for special purposes. In the second section, the wrought alloys are considered, and photomicrographs are given of oxy-acctylene welds in Bondur, Lautal, Mangal, Pantal, K.S.-Seewasser, Hydronalium, and other well-known alloys. Emphasis is placed on the necessity of using a flux to suit the particular alloy to be welded. The casting alloys are then dealt with, Elektron being included in a list of "aluminium casting alloys," and the importance of the freezing range, and its influence on the welding properties of a casting, is stressed. Some particulars of aluminium solders and their properties are also given. In the next section, the corrosion of aluminium welds is briefly discussed, and the fifth and sixth sections are devoted to the preparation and properties of joints between aluminium and other materials, such as copper, iron, nickel, &c. Appended are a copy of DIN 1713, a table of "weldability" of non-ferrous materials, and 25 data sheets illustrating recommended practice.

Although the descriptions are often too brief and sometimes too vague to convert a mild steel welder into an expert craftsman in light alloys, yet there is a lot of information in this booklet which will be valuable to all interested in non-ferrous welding, and, at the price asked, few can afford to be without it.--M. W. G. HIGNETT.

# Der Kupfer-, Messing-, Nickel-, Blei-Schweisser. Von Hermann Holler. $15 \times 21$ cm. Pp. 71, with 71 illustrations. 1936. Halle a. S.: Carl Marhold. (R.M. 1.50.)

A book on non-ferrous welding, small though it be, is indeed a noteworthy addition to welding literature. Written by an author of international repute, and excellently printed, this booklet must be regarded as "dirt cheap" at the price, and will be of interest to all concerned in welding any of the following materials : copper, brass, Cuprodur, Monel metal, nickel, bronze, nickel silver, zinc, aluminium bronze, bimetals, and lead. The first 44 pages are devoted to the oxy-acetylene welding of these; then follow some remarks on the corrosion of non-ferrous welds; a table, giving the welding characteristics of a wide range of metals and alloys; and 19 data sheets of recommended practice for typical jobs.

In one or two respects, the text is a little vague, if not misleading. Much too great an emphasis is placed on the need for special fluxes, and too little on the more essential control of flame conditions. The double-bead vertical method for welding copper is not described in the text, although it is illustrated in the data sheets. The figures given for the mechanical properties of copper welds are out-of-date. In the case of nickel, the most vital of all factors, the quality of the parent metal, is not mentioned. Several of the illustrations have little value in complementing the text; Fig. 33, for example, shows the twinned structure, typical of rolled and annealed sheet, in what purports to be a weld, and many of the welds illustrated appear to leave much to be desired.

Flanging the edges of copper, aluminium, and nickel sheets over 11 mm. thick (as recommended in the first data sheet) is a time-consuming, expensive, and quite unnecessary operation.—H. W. G. HIGNETT.

Procedure Handbook of Arc-Welding Design and Practice. Fourth Edition. Demy 8vo. Pp. xii + 819, with 990 illustrations. 1936. Cleveland, O.: The Lincoln Electric Company. (\$1.50 in U.S.A.; \$2.00 elsewhere, post paid); Toronto: Lincoln Electric Co. of Canada, Ltd.; Welwyn Garden City, Herts.: Lincoln Electric Co., Ltd. (8s. 6d. post free).

The third edition of this book was reviewed in *Met. Abs.*, 1930, 3, 189, and the early appearance of another edition is testimony to the well-deserved popularity of the book. No remarkable changes or additions are to be noted, but the value offered is even better than before. One would still like to have more information on the non-ferrous metals, and a section on the metallography and radiography of welds would be welcome in a future edition.

-H. W. G. HIGNETT.

Das zeitgemässe Schweissen. Ein Kurzgefasstes Handbuch. Von W. Sochting. Teil I.—Das Elektroschweissen. (Bibliothek der gesamten Technik, Nr. 425.)  $15 \times 21$  cm. Pp. 64, with 63 illustrations in the text and 16 plates. 1936. Leipzig: Max Jänecke. (M. 1.20.)

It is a curious convention that a book on electric welding must include both arc and resistance processes although they have little in common save a dependence on electricity. In this little booklet, for example, is given an admirable account of arc welding theory and practice—brief, it is true, but nevertheless, very informative—and, at the end, is tacked on a section of 5 pages to deal with the whole available knowledge of resistance welding. Are welders will find, in this booklet, concise and up-to-date information, illustrated by clear diagrams, but the resistance welder is given the bare principles of butt-, spot-, and seamwelding. An index would be an advantage, and one would like to see some mention of the non-ferrous metals.—H. W. G. HIGNETT.

Alchemy and Other Chemical Achievements of the Ancient Orient. The Civilization of Japan and China in Early Times as seen from the Chemical Point of View. By Masumi Chikashige. Cr. 8vo. Pp. ix + 102, with numerous illustrations. 1936. Tokyo: Rokakuho Uchida. (Yen 1.50.)

This interesting little booklet deals with Oriental alchemy, bronze articles, and Japanese swords. It is a translation of a work by the author. This included an outline of Western alchemy, which stands in marked contrast to Oriental alchemy. The latter was stimulated by the search for the *elixir eita*, the elixir whereby longevity was to be attained, and which necessarily contained gold. Western alchemy originated with the desire to make gold or an imitation of gold from the base metals; longevity was sought in order that sufficient time might be found for enjoying the gold so made. Here the tale of Oriental alchemy is well told; it is claimed that it is as old as, if not older than, Western alchemy. The translation of the text into English has been extremely well dong—there are fewer errors than characterize most English books. Alchemy must have given the Orientals opportunity for some exciting adventures. Listen (p. 34)—" The root of a thousand-year old juniper has the form of a sitting man and is seven inches long. Cover the sole with it, and you can wake on water. Smear the nostrils with it and you can stay a long time on the river bottom. Cover the body with it and you will be at once invisible." This is only one of the wonders known to the Oriental alchemist. Metallurgists will probably be more interested in the sections of this booklet devoted to bronzes and swords. Six recipes for bronze are given, the percentage of copper ranging from 86 to 50%. Analysis reveals that the bronzes contained, in addition, yarious proportions of lead, nickel, antimony, arsenic, and from. Dr. Chkashige is quite up to date in his appreciation of the Oriental sword. " None of the natives of the Pacific Coast," says he, " can rival us in the quality of our swords. Our country has long been noted for its millitary power. A good many causes for this mildt be advanced but one is certainly the supremacy of its swords." *O tempora*, *O mores.*—J. S. G. THOMAS.

Industrial Dust; Hygienic Significance, Measurement, and Control. By Philip Drinker and Theodore Hatch. Med. 8vo. Pp. viii + 316, with 104 illustrations. 1936. New York: McGraw-Hill Book Co., Inc. (\$4.00); London: McGraw-Hill Publishing Co., Ltd. (24s. net.).

This is an important book on a very important subject—the dust hazard in industry. If it is true, as has been said, that everybody is expected to cat a peck of dust in a life-time, then it is equally true that I have visited factories where I have swallowed my life-quotum of that material in an afternoon. The dust hazard is a very real menace in industrial, and indeed, in our ordinary daily life. Its control is the joint duty of the physician and engineer; neither of these, alone, sees the problem whole. This book, written from the engineer's point of view, should do much to enable physicians to understand more fully the engineering aspects of the problem, and vice versa.

Chapters are devoted to the physical properties of dusts, fumes, and mists, their effects on man, pneumonoconiosis, permissible dustiness, dust survey, dust determination, particle sizes, dust analyses, control of the dust hazard, design of exhaust systems, air-cleaning apparatus, respirators and air masks. The treatment throughout is thoroughly up to date; the section on sillcosis is very well done. The more purely physical section of the work could be improved somewhat, but that is a matter of minor importance in this essentially practical work. A bibliography of 260 references and adequate name and subject indexes are appended.

The book is well produced on good paper, is well illustrated, and its price is reasonable. It should find its way into every industrial library.—J. S. G. THOMAS,