METALLURGICAL ABSTRACTS

(GENERAL AND NON-FERROUS)

I.—PROPERTIES OF METALS

*Contribution to Our Knowledge of the Deformability of Aluminium as a Function of Its Purity. Werner Helling (*Aluminium*, 1936, **18**, (7), 306–309).— Tables and graphs are given showing the mechanical properties of 99·29–99·977% aluminium after deformations of 0–95% reduction. The results show that the strength increases, the ductility and malleability decrease, and the hardness changes relatively slightly with increasing content of impurities. In general, the higher the content of impurity the greater is the hardening produced by cold-work, and therefore the smaller is the capacity of the metal to undergo severe deformation ; this is particularly marked in the twist test, and to a smaller extent in the Erichsen test on half-hard sheet.—A. R. P.

*Electrical Conductivity Measurements on Welded Pure Aluminium. P. Buser (*Aluminium*, 1936, **18**, (8), 364–366).—Measurements on cast and rolled aluminium show that the theoretical loss in conductivity with an infinite number of welds should not exceed 10%. Tests on actual welded rods showed losses of 4% when the welds were badly made, but a rod 1 m. long with 10 welds showed a loss of conductivity of 1·7% with 99·5% aluminium and 1·1% with 99·9% aluminium. A bus-bar (7 × 10 mm.) of pure aluminium with 11 welds in 3 m. length showed a decrease of 1·2% in conductivity. The increase in resistance produced by welding high-grade aluminium can be kept very small by maintaining a 2 : 1 iron : silicon ratio in the metal, annealing the weld at 300° C. and hammering it whilst hot.—A. R. P.

*The Rate of Crystallization of Aluminium and Gold. Zofja Beckerówna (*Wiadomości Institutu Metalurgi i Metaloznawstwa (Warszawa)*, 1934, **1**, (1), 7–10).—[In Polish, with French abstract.] Experiments were carried out to determine the liability of aluminium to supercooling. With aluminium of 99·5% purity the supercooling was 25°. Experiments on the rate of crystallization of aluminium and gold by Czochralski's method showed that aluminium is obtained as a single crystal or polycrystalline rod, depending on the rate of withdrawal from the molten bath ; if this rate is less than 40 mm./minute, under certain conditions, single crystals are obtained. This value may be considered the maximum linear rate of crystallization of single crystal aluminium. The relation between direction of growth of the crystal, the temperature of the metal, and the speed of withdrawal of the rod were observed. Impurities decreased the rate of crystallization. Gold single crystals were obtained as dendrites ; the maximum rate of linear crystallization was 24 mm./minute.—L. A. O.

Calcium. Alfred Schulze (*Chem.-Zeit.*, 1936, **60**, (72), 733–735).—A review of the preparation, properties, and uses of metallic calcium.—A. R. P.

*The Magnetic Properties of Chromium. L. F. Bates and A. Baqi (*Proc. Phys. Soc.*, 1936, **48**, (5), 781–794).—Pure chromium was prepared from chromium amalgam, and its magnetic susceptibility was studied over the range 90°–620° K. The mass susceptibility is practically constant over this range, the slight departures from constancy being partly explainable by the effects of thermal expansion on the experimental results. The mean susceptibility is $3·08 \times 10^{-6}$ e.m.u. per grm. at room temperature. The effects of

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* Denotes a paper describing the results of original research.
† Denotes a first-class critical review.

impurities on the magnetic behaviour of chromium, which are very pronounced in the case of samples prepared at lower temperatures, are considered in detail, and the thermal and magnetic data for this element are discussed on the basis of modern theories of paramagnetism of metals.—S. G.

Columbium : From a Laboratory Curiosity to a Widely Used Commercial Product. James H. Critchett (*Trans. Electrochem. Soc.*, 1936, **69**, 62–65; and *Met. Ind. (Lond.)*, 1936, **48**, (25), 688).—S. G.

*****The Density and Coefficient of Expansion of Liquid Gallium Over a Wide Range of Temperature.** W. H. Hoather (*Proc. Phys. Soc.*, 1936, **48**, (5), 699–707; discussion, 707).—Accurate measurements of the density and coeff. of expansion of liquid gallium at 30°–1000° C. were made by a dilatometric method. The temperature was measured with a platinum resistance thermometer. An equation expressing the increase in volume as a function of the temperature was found, and from that equation values were calculated for the coeff. of expansion.—S. G.

*****The Electrical Resistance of Gold and Silver at Low Temperatures.** W. J. de Haas and G. J. van den Berg (*Physica*, 1936, **3**, (6), 440–449; and *Comm. K. Onnes Lab. Leiden*, No. **241d**).—[In English.] In agreement with previous measurements (W. J. de Haas, J. de Boer, and G. J. van den Berg, *Met. Abs.*, 1935, **2**, 200), the resistance curves of the gold wires measured show a minimum. The " ideal " resistance calculated by means of Matthiessen's rule, without taking into account the points below the temperature of the minimum, increases proportionally to $T^{4\cdot2}$. The minimum shifts to higher temperatures, when the residual resistance increases. One of the samples of silver also showed a minimum. The " ideal " resistance, calculated in the same way as for gold, increases proportionally to $T^{4\cdot1}$.—S. G.

*****The Rate of Crystallization of Lead and of Its Alloy with Mercury.** Irena Makowska (*Wiadomości Institutu Metalurgi i Metaloznawstwa (Warszawa)*, 1934, **1**, (1), 14–16).—[In Polish, with French abstract.] The critical speeds of crystallization of lead and of lead–mercury alloys were measured by Czochralski's method. For lead, this speed decreased the higher the temperature of the molten metal. The maximum speed obtained at 329° C. was 170 mm./minute. The speed of crystallization of an alloy containing 5% mercury was 100 mm./minute at 309° C.—L. A. O.

*****The Recrystallization Diagram of Magnesium.** I. Feldman (*Wiadomości Institutu Metalurgi i Metaloznawstwa (Warszawa)*, 1934, **1**, (1), 21–25).—[In Polish, with German abstract.] A recrystallization diagram for magnesium was constructed, which does not differ appreciably from earlier diagrams. The reductions of the test-pieces on compression were 3, 6, 9, and 12%; further compression caused fracture. The test-pieces were annealed at various temperatures for 30 minutes; commercial magnesium was used. Test-pieces of chemically-pure, rolled magnesium, subsequently pressed together, showed different properties along different axes after annealing at 500° C. This was considered to be connected with the formation of grain structure due to rolling. A new polishing and etching method for magnesium is described, and information is given on the microscopic structure of the metal.—L. A. O.

*****On a New Magnetostriction Experiment [Nickel].** J. L. Snoek (*Physica*, 1936, **3**, (4), 205–206).—[In French.] Perrier's experiment (*Helv. Phys. Acta*, 1935, **8**, 427) depends on a film of oxide, and is a variant of the Wiedemann effect.—S. G.

*****The Rate of Crystallization of Tin.** Hanna Jabłońska (*Wiadomości Institutu Metalurgi i Metaloznawstwa (Warzsawa)*, 1934, **1**, (1), 11–13).—[In Polish, with German abstract.] Tin single-crystals were prepared at 236° and 238° C. by Czochralski's method at different rates. The critical speed was 100–85 mm./minute. The relationship was determined at these temperatures, between

the mean area of cross-section and the mean volume rate of crystallization at the rate of drawing.—L. A. O.

*Measurements of the Latent Heat of Tin in Passing from the Superconductive to the Non-Superconductive State. W. H. Keesom and P. H. van Laer (*Physica*, 1936, **3**, (6), 371–384; also *Comm. K. Onnes Lab. Leiden*, No. **242a**; and (summary) *Proc. K. Akad. Wet. Amsterdam*, 1936, **39**, (5), 573–574).—[In English.] The results are given of some latent heat measurements on tin in connection with the transition from the superconductive to the non-superconductive state while a constant magnetic field is being applied. The range of the transition region, as demonstrated by the occurrence of the transition heat, agrees almost exactly with what can be calculated in connection with the form of the block. It is concluded that in the transition, if performed in this way, no irreversible heat process takes place. The way in which the magnetic field penetrated the block is considered. Some measurements of the latent heat were made at constant temperature. The results are discussed.—S. G.

*On the Transition of a Tin Sphere from the Non-Superconductive State to the Superconductive State. W. J. de Haas and O. A. Guinau (*Physica*, 1936, **3**, (6), 534–542; and *Comm. K. Onnes Lab. Leiden*, No. **241b**).—[In English.] Cf. *Met. Abs.*, this vol., p. 240. Two cases were studied in both of which a non-superconductive tin sphere changes into the superconductive state. It is shown that the changes of field strength at these transitions show much analogy with those of the opposite transition; yet the phenomena are certainly not exactly reversible. Lippmann's rule is not valid in the body of the sphere. The currents which should be responsible for the distribution of the field strengths found have directions opposite to those predicted from Lippmann's rule.—S. G.

*Action of a Few Gases on Metallic Titanium and Titanium Nitride. Masami Kobayashi (*Kinzoku no Kenkyu* (*J. Study Metals*), 1936, **13**, (7), 291–299).—[In Japanese.] Metallic titanium (99·2% Ti) and titanium nitride (19·4% N) were heated at high temperatures in air, oxygen from bomb (containing 97·7% O_2), nitrogen from bomb (containing 1·0% O_2), pure carbon dioxide and pure carbon monoxide. Both titanium and titanium nitride were oxidized to TiO_2 by all these gases except carbon monoxide. It was found that carbon monoxide had no action on titanium nitride at 1000°–1100° C., but there was an action on titanium at 1000°–1180° C.; this was shown by an increase in weight and by total carbon (by the combustion method) in the product.—S. G.

*Tables of the Emissivity of Tungsten as a Function of Wave-Length from 0·23–2·0 μ in the Region of Temperature 1600°–3000° K. L. S. Ornstein (*Physica*, 1936, **3**, (6), 561–562).—[In English.] Results obtained in 1934 by H. C. Hamaker for the region 0·23–1·00 μ are combined with new results obtained by D. Vermeulen and J. J. Zaalberg van Zelst for the region 0·8–2·0 μ.—S. G.

The Fundamental Equations of Elasticity with Special Reference to the Behaviour of Solids and Liquids under Extreme Pressures. F. D. Murnaghan (*Science*, 1935, **81**, (2105), 422).—Read before National Academy of Sciences, Washington. For media under uniform (hydrostatic) pressure, p, it is found that p is a function of e where $e = (V_0/V)^{2/3} - 1$. Bridgman's results for lithium, sodium, and potassium, tested within the pressure range of 2000 to 20,000 atm., agree with the formula $p = ae + be^2 + ce^3$ to within $\frac{1}{2}$%. The values of the constants were found to be, lithium : $a = 179.11 \times 10^3$; $b = 140.0 \times 10^3$; $c = 145 \times 10^4$; sodium : $a = 94.13 \times 10^3$; $b = 251.8 \times 10^3$; $c = 47 \times 10^3$; potassium : $a = 44.81 \times 10^3$; $b = 124.72 \times 10^3$; $c = 142.5 \times 10^3$.—J. S. G. T.

Elastic Structures under Rapidly Applied Loading. A. M. Roberts (*Mech. World*, 1936, **99**, 441–444, 470–471, 495–496, 504).—The stress induced in a structure by sudden application of a load is twice the stress produced by the

same load under static conditions. A detailed account is given of original work to determine what happens for a large number of loading conditions lying between these extremes and actually encountered in practice.—F. J.

Metals under High Pressure. —— (*Metallurgist* (Suppt. to *Engineer*), 1936, **10**, 125–127).—An account of work by P. W. Bridgman, *Phys. Rev.*, 1935, [ii], **48**, 825; see *Met. Abs.*, this vol., p. 2.—S. G.

*Physical Properties of Surfaces. III.—The Surface Temperature of Sliding Metals. The Temperature of Lubricated Surfaces.** F. P. Bowden and K. E. W. Ridler (*Proc. Roy. Soc.*, 1936, [A], **154**, (883), 640–656).—A method is described for measuring the surface temperature of sliding metals. The temperature reached depends on the load, speed coeff. of friction, and thermal conductivity of the metals, and is in good agreement with theory. With readily fusible metals the surface temperature reached corresponds to the melting point of the metal. With less fusible metals the local surface temperature may exceed 1000° C. Even with lubricated surfaces the temperature (under boundary lubrication conditions) is high, and may exceed 600° C. This high surface temperature will cause a local volatilization and decomposition of the lubricant, and is a cause of the breakdown of the boundary film.—S. G.

Ultrasonic Waves. E. Hiedemann (*Stahl u. Eisen*, 1936, **56**, (21), 600–603). —The special properties of ultrasonic waves which are of use in the iron industry are discussed; they have certain general applications. Ultrasonic waves are defined as those having frequencies greater than 17 kH_z. The production of such waves by magnetostriction, piezoelectric effects, and the Galton pipe are described. The application of the transmission of the waves through large metallic bodies to the detection of cavities or of foreign bodies having different transmission characteristics is discussed. The operation of powerful ultrasonic waves results in correspondingly strong mechanical stresses, which affect the internal crystal structure. Boyle has applied these waves to the degassing of molten metal and Wood and Loomis to the preparation of extremely fine emulsions.—W. A. C. N.

*Collective Electron Specific Heat and Spin Paramagnetism in Metals.** E. C. Stoner (*Proc. Roy. Soc.*, 1936, [A], **154**, (883), 656–678).—Expressions are obtained for the spin paramagnetism and electronic specific heat, and their temperature variation, as dependent on the number of states per unit energy range, ν (ϵ), at the top of the Fermi distribution in collective electron energy bands, and the variation of this number with energy, ϵ. A simple method is developed for determining the general character of the effect of interchange interaction. The magnetic properties of the elements in the first two columns of the periodic table, and of the transition elements and rare earths are briefly considered, and also the specific heat of nickel and platinum.—S. G.

†**Crystal Structure and Ferromagnetism of the Transition Metals.** Ulrich Dehlinger (*Z. Metallkunde*, 1936, **28**, (5), 116–121).—The following aspects of the subject are critically reviewed in the light of recent work : relations between crystal structure and physical properties, electronic principles of ferromagnetism, maximum possible value of the saturation magnetization, actual value for the transition metals and the causes of the difference between the theoretical and actual values for nickel, cobalt, and iron.—A. R. P.

*On the Anti-Ferromagnetic Interchange Problem at Low Temperatures.** L. Hulthèn (*Proc. K. Akad. Wet. Amsterdam*, 1936, **39**, (2), 190–200).—[In German.]—S. G.

*Note on Magnetic Hysteresis and Time Effects in Superconductors.** K. Mendelssohn and R. B. Pontius (*Physica*, 1936, **3**, (5), 327–331).—[In English.] Two kinds of magnetic hysteresis in superconductors are distinguishable. The first, which the " freezing in " of a part of the flux of force produces, is ascribed to a superconducting ring-shaped region of high threshold value. This form of hysteresis appears to occur especially in impure polycrystalline

substances. The second type can be considered as a super-cooling of a condition in the other. This hysteresis was observed in single crystals or specimens which were very pure and probably consisted of a few large crystals. In connection with the setting-in of supercooling, the fact seems to be that after a sudden change of the variable condition the establishment of equilibrium between superconducting and non-superconducting material requires considerable time.—S. G.

*On the Theory of Magnetic Fields in Superconductors. F. London (*Physica*, 1936, **3**, (6), 450–462).—[In German.] Starting from the theory of the pure superconductive state, a theory of the " intermediate " state is developed, the characteristic feature of which is the appearance of a macroscopic magnetic induction B. Considering the surface energy of the pure superconductive state, as postulated by C. J. Gorter and H. London, the energy density of such an " intermediate " state is calculated to be given by $U = -\dfrac{H^{2}}{2} +$

$H_T|B|$. ($|B| \leq H_T$), where H_T is the magnetic threshold value.—S. G.

New Phenomena of Superconductivity. Karl K. Darrow (*Rev. Sci. Instruments*, 1936, [N.S.], **7**, (3), 124–132).—Recent researches on superconductivity are briefly reviewed, especially as regards the influence of magnetic fields on superconductors. The investigations of Meissner, Mendelssohn, Simon, and their collaborators are discussed in particular.—S. G.

Relaxation Phenomena in the Transition from the Superconductive to the Non-Superconductive State. W. H. Keesom and P. H. van Laer (*Proc. K. Akad. Wet. Amsterdam*, 1936, **39**, (2), 148–149).—[In English.] Summary of a paper printed in full elsewhere ; see *Met. Abs.*, this vol., p. 245.—S. G.

Approximate Method for Calculating the Work-Function of Metals. E. H. B. Bartelink (*Physica*, 1936, **3**, (4), 193–204).—[In German.] Mathematical.
—S. G.

II.—PROPERTIES OF ALLOYS

*Magnetic Susceptibility and Change of State of the Hardenable System Aluminium–Copper. Hermann Auer (*Z. Metallkunde*, 1936, **28**, (6), 164–175). —By measuring the paramagnetic susceptibility (χ) of copper–aluminium alloys in the homogeneous quenched state and during ageing it is possible to follow the precipitation of the copper from solid solution and to determine the boundaries of the α-phase at high temperatures and the position of the solidus in hypoeutectic alloys. If the values of χ for various alloys quenched from different temperatures are plotted against the quenching temperature, the curves are all concave to the origin up to the α-phase boundary, then parallel to the axis of temperature up to the solidus, after which they rise almost vertically ; the two inflection points thus established for various copper contents are in close agreement with the values for the solid solubility of copper in aluminium and the solidus established by thermal and X-ray analysis. Susceptibility–time of ageing curves for temperatures below 200° C. are straight lines when the time is plotted on a logarithmic scale ; this indicates that the increment (dc) in copper-rich constituent is a logarithmic function of the temperature (T) and time of annealing (t) and can be expressed as follows : $\dfrac{dc}{dt} = A \cdot e^{-\beta/T} \cdot \dfrac{D}{t}$. The susceptibility is thus proportional to the enrichment of the copper atoms in the lattice, and is not affected by a reconstruction of the lattice after rejection of the copper atoms. The theoretical implications of these results in the study of the mechanism of precipitation from a solid solution are discussed at some length.—A. R. P.

*The Iron–Aluminium–Carbon System. —— (*Metallurgist* (Suppt. to *Engineer*), 1936, **10**, 148–149).—Summary of paper by R. Vogel and H. Mader, *Arch. Eisenhüttenwesen*, 1935–1936, **9**, (7), 333 ; see *Met. Abs.*, this vol., p. 147. —S. G.

†Aluminium Alloys with a $MgZn_2$ Content as Casting Alloys. H. Schmitt and P. Bergmann (*Aluminium*, 1936, **18**, (8), 370–373).—Casting alloy G 54 with about 9% $MgZn_2$ has a density of 2·84 (chill-cast) or 2·79 (sand-cast), a shrinkage of 1·25%, and tensile strength of 13·6–14·2 (sand-cast), 16·1–17·6 (chill-cast and air-cooled from 300° C.), or 23·8–26 kg./mm.² (heat-hardened) with corresponding Brinell hardness of 75–86, 88–97, and 112–133. The metal gives good castings provided that it is protected from access of gas during melting. Heat-treatment comprises quenching from 500° C. in oil and reheating at 130° C. for 14 hrs. The cast alloy has a good resistance to corrosion, which can be further improved by the Eloxal treatment.—A. R. P.

Recent Scientific and Practical Information on Silumin. E. Scheuer (*Schweiz. Archiv angew. Wiss. Tech.*, 1936, **2**, (4), 85–96).—A general paper giving a summary of data obtained within recent years on the varieties of Silumin, their constitution, casting properties, freedom from gaseous inclusions, the influence of small additions of sodium and lithium and of partial undercooling, the effect of magnesium in giving increased hardness, tensile strength, and fatigue strength.—W. A. C. N.

Castings in Silumin Gamma. G. Sachs and E. Scheuer (*Metal Treatment*, 1936, **2**, (6), 94–98 ; and *Found. Trade J.*, 1936, **55**, (1048), 218–220). —Abridged translations from *Metallwirtschaft*, 1935, **14**, (47), 937 ; (48), 972 ; see *Met. Abs.*, this vol., p. 36.—J. C. C.

Contribution to the Knowledge of Faults in the Working of Hardened Light Metals in Orthopædia. Herm. A. J. Stelljes (*Aluminium*, 1936, **18**, (7), 302–305).—Methods of preventing fracture and corrosion of age-hardened aluminium alloys used in orthopædic apparatus are described.—A. R. P.

*On the Nature of the Peritectic Reaction [in the System Antimony–Tin–Lead], and the Mechanism of the Grain-Refinement Resulting Therefrom. Keizo Iwasé, Ju-n Asato, and Nobuyuki Nasu (*Kinzoku no Kenkyu* (*J. Study Metals*), 1936, **13**, 213–222 (in Japanese, with English summary) ; and *Nippon Kwagaku Kwaishi* (*J. Chem. Soc. Japan*), 1936, **57**, (4), 310–317 (in Japanese)). —The nature of the peritectic reaction is studied in the case of the ternary antimony–tin–lead alloys.—S. G.

*The Iron–Chromium Alloy System. The Brittle Non-Magnetic Phase. Eric R. Jette and Frank Foote (*Metals and Alloys*, 1936, **7**, (8), 207–210).— Very pure alloys with a 1 : 1 atomic ratio of iron and chromium (electrolytic) undergo a transformation at 600°–800° C., the α-phase being converted into the brittle, non-magnetic Σ-phase. This takes place extremely slowly if the alloy is exceedingly pure and thoroughly homogenized by a prolonged anneal at 1300° C., but is considerably accelerated by cold-working after annealing at 1000° C., or by the presence of small quantities of silicon (*e.g.* 0·09%). The Σ-phase has a very complex X-ray structure, and appears to be a secondary solid solution (Hume-Rothery nomenclature).—A. R. P.

Beryllium–Copper–Cobalt Alloys [Trodaloy No. 1]. F. G. Benford (*Met. Ind. (Lond.)*, 1936, **49**, (2), 40).—A brief description of the properties of Trodaloy No. 1, containing copper 97, beryllium 0·4, cobalt 2·6%. It is cheaper than the binary copper–beryllium alloy, with a superior electrical conductivity, and is suitable for electrodes for welding.—J. E. N.

*Some Metallurgical Properties of Copper–Nickel (70 : 30) Condenser Tubes. Joseph A. Duma (*J. Amer. Soc. Naval Eng.*, 1936, **48**, (3), 397–410).—Factors affecting the cold-working of 70 : 30 copper–nickel alloy condenser tubes are hardness, which should not have too wide and too fluctuating a range ; copper content which should not be in excess of 70% in straight copper–nickel

tubes and should not exceed 80% in tubes containing small proportions of other elements; oxygen content, which, if high, causes embrittlement of the tubes with splitting in belling and expanding operations; and annealing treatment, which should be at 870° C. followed by water quenching. Tubes which have been cold-worked too severely and not annealed are worthless and entirely unsuitable for cold-forming unless annealed. Factors detrimental to the corrosion-resistance of 70 : 30 tubes are the mercurous nitrate test, and boiling salt-water in which tubes having a Brinell hardness of 40–50 show the minimum corrosion.—J. W. D.

*On Hardenable Bronzes with a Copper–Nickel–Tin Basis. I.—Alloys for Sand Castings. E. Fetz (*Korrosion u. Metallschutz*, 1935, 11, (10), 217–229).— By an appropriate homogenizing heat-treatment all alloys with up to 10% tin and 40% nickel can be brought into a workable state and then hardened by a precipitation treatment at lower temperatures for a long period. The maximum hardening effect is obtained with a nickel : tin ratio of 1 : 1 by weight, the maximum hardness reached being directly proportional to the degree of supersaturation. Hardening curves are given for a large number of alloys, and a close relationship has been established between the melting-point and the rate of hardening of sufficiently supersaturated α-alloys. Nickel considerably improves the mechanical properties of α-bronze sand-castings, especially the elongation and limit of proportionality; apart from this, substitution of nickel for half the tin has certain economical advantages.
—A. R. P.

*On the Age-Hardening of Brass. Kanzi Tamaru (*Kinzoku no Kenkyu (J. Study Metals)*, 1936, 13, (4), 150–155).—[In Japanese.] See *Met. Abs.*, 1935, 2, 575.—S. G.

†High Tensile Strength Brasses. A Review of Their Properties and Uses. H. J. Miller (*Met. Ind. (Lond.)*, 1936, 49, (9), 201–206; (10), 229–233).—The effects of the addition to the 60 : 40 copper–zinc type of alloy of tin, manganese, iron, aluminium, lead, nickel, and silicon, singly and in groups, on the mechanical and corrosion-resisting properties are reviewed. Many tables of compositions with correlated physical properties are quoted, and there is a useful *bibliography* of 65 references.—J. E. N.

Researches on Tungum Alloy. B. C. Laws (*Shipbuilder*, 1936, 43, (320), 442–444).—The strength of Tungum—a special brass—and its high resistance to oxidation at normal and elevated temperatures are discussed. Complete tests are given showing its mechanical properties in the soft and hard-rolled, soft-forged, and cold-forged conditions. Laboratory corrosion tests in sea-water show a rapidly diminishing rate of deterioration after 25 days, at which the wastage is 0·000413 grm./cm.^{2}, and an estimated maximum loss of 0·00055 grm./cm.^{2} after 95 days. The breaking stress of Tungum wire rope before and after two years' exposure in wind and sea-water is given as 67·3 and 64·4 tons/in.^{2}. Reference is also made to recent marine uses of Tungum alloy for deck winches, propeller shafts, and propeller brackets.—J. W. D.

*The Rate of Crystallization of Lead and of Its Alloy with Mercury. (Makowska.) See p. 386.

*Testing the Running Properties of Various New Bearing Metals with Special Reference to the Lead Bearing Metals. M. von Schwarz [with F. Kolb] (*Z. Metallkunde*, 1936, 28, (5), 128–130).—The running properties of various lead-base bearing metals containing arsenic, antimony, copper, tin, zinc, cadmium, magnesium, and aluminium have been tested in the bearing testing machine described by S. in *Z.V.d.I.*, 1928, 72, 1098. The results show that alloys with a relatively high tin content (*e.g.* 20–40%) are inferior to antimonial-lead alloys with a small percentage of copper. Addition of 5% cadmium to the 15% antimony–lead alloy gives an alloy superior to that produced by addition of copper. Zinc, on the other hand, produces a much

harder alloy having a tendency to run hot. Arsenical lead or lead–antimony alloys make satisfactory bearings for certain purposes and a 1·1% magnesium–lead alloy has excellent running properties equal to some of the best high tin-base alloys.—A. R. P.

*White Bearing Metals with a Lead–Tin Base. (Frhr.) von Göler and F. Scheuer (*Z. Metallkunde*, 1936, **28**, (5), 121–127; (6), 176–179).—Standard German specifications for lead–tin-base bearing metals are discussed, and the properties of such metals containing antimony 13–15·5 and copper 0–5% with varying proportions of tin and lead are shown graphically. The strength increases and the capacity for deformation decreases with increase in the tin content from 0 to 10%; further increase of the tin content to 42% has little effect on the strength of the alloys, but decreases the endurance limit, capacity for deformation, and hardness at elevated temperatures. The presence of small amounts of copper in the alloys has little effect on their mechanical properties, but is beneficial in preventing undue segregation in the castings. The results obtained indicate that alloys with an intermediate tin content are inferior to the lead-rich alloys, as well as being most costly to produce. A *bibliography* of 65 references is appended.—A. R. P.

*The Magnetic Properties of Amalgams. L. F. Bates and L. C. Tai (*Proc. Phys. Soc.*, 1936, **48**, (5), 795–809).—The magnetic susceptibilities of a series of amalgams of known concentrations of bismuth, chromium, copper, and manganese with mercury were studied at room temperature, the Gouy method of measurement being employed in all cases. A study of the drop-weight method for measuring susceptibilities showed it to be quite unreliable for measurements with amalgams. In dilute amalgams, manganese was found to possess an apparent atomic susceptibility of $+ 13,700 \times 10^{-6}$, bismuth $+ 133 \times 10^{-6}$, chromium $+ 23 \times 10^{-6}$, and copper about $- 7·3 \times 10^{-6}$ e.m.u. All metals so far studied which are diamagnetic in the solid state are paramagnetic in dilute amalgams, with the possible exception of copper.—S. G.

*Electrolytic Reductions of Organic Compounds at Alloy Cathodes. I.— Reduction of Aliphatic Ketones to Hydrocarbons at Cadmium Amalgams. Sherlock Swann, Jr., H. J. Read, and F. C. Howard (*Trans. Electrochem. Soc.*, 1936, **69**, 345–350; discussion, 350–352).—See *Met. Abs.*, this vol., p. 200. —S. G.

*The Magnetic Properties of Hardened Beryllium–Nickel Alloys. Walther Gerlach (*Z. Metallkunde*, 1936, **28**, (7), 183–188).—Graphs are given showing the relation between the magnetic properties and the temperature for beryllium–nickel alloys in the precipitation-hardened state with and without cold-working in the soft state. Alloys hardened after cold-work, and ordinary hard-drawn alloys show a very steep increase in coercivity at the Curie point, whereas those hardened directly from the quenched state do not show this anomaly; this is considered to be evidence in support of the theory that cold-working of the quenched alloy produces precipitation of part at least of the Be in super-saturated solid solution. The shape of the hysteresis curves above and below the Curie point indicates the probability that the high coercivity is due to a new state of the alloy which is formed by heating at the Curie point.—A. R. P.

Inconel. R. Hanel (*Chem. Fabrik*, 1936, **9**, (19/20), 217–220).—Information is given on the physical properties, heat-resistance, working, heat-treatment, surface treatment, welding, and uses of Inconel.—A. R. P.

*The Volume Changes in the Magnetization [of Iron–Nickel Alloys] and the Invar Alloys. Ulrich Dehlinger (*Z. Metallkunde*, 1936, **28**, (7), 194–196).—The decrease in volume of iron–nickel alloys which is caused by demagnetization as the temperature approaches the Curie point can be calculated from the exchange integral curve derived from measurements of the saturation moments. These curves show that this decrease in volume is particularly great with the Invar

alloys, and thus an explanation is afforded of the peculiar magnetic properties of these alloys.—A. R. P.

†**Permalloys and Related Ferro-Magnetic Alloys.** J. C. Chaston (*Metal Treatment*, 1936, **2**, (6), 58–66, 71 ; and *Elect. Communication*, 1936, **15**, (1), 38–51).—A review. The magnetic characteristics of the easily-magnetized group of alloys are outlined and an account is given of the properties of the nickel–iron series after various heat-treatments. The development of the nickel–iron–copper, nickel–iron–molybdenum, nickel–iron–chromium, and more complex alloys, giving high values of resistivity and initial permeability after a simple heat-treatment, and of the nickel–iron–cobalt alloys having a constant value of permeability over a wide range of field strengths, is described, and various theoretical explanations outlined. The effects of crystal size, crystal orientation, cold-working (in the production of " Isoperm "), heat-treatment in a magnetic field, and impurities are also dealt with and reference made to the action of dissolved hydrogen. A *bibliography* of 36 references is appended.—J. C. C.

***The Hardness of Silver-Zinc Alloys in Relation to the Composition.** G. I. Petrenko and E. E. Tscherkaschin (*Z. anorg. Chem.*, 1936, **227**, (4), 415–416).—The Brinell hardness of silver–zinc alloys shows a feeble maximum (35) at 10% zinc in the α-phase and then falls to that of silver (30) at the limiting solid solution. With further addition of zinc there is a steep increase to 95 at the $(\alpha + \beta)–\beta$ boundary, followed by a decrease to 85 at AgZn, a sharp increase to 200 at Ag_2Zn_3, a sharp decrease to 50 at Ag_2Zn_5, and a somewhat less steep decrease to 25 at the $\delta–(\delta + \epsilon)$ boundary. The curve then rises to a maximum of 35 at the $(\delta + \epsilon)$-ϵ boundary and finally falls to 25 for pure zinc.—A. R. P.

***Tantalum–Iron Alloys and Tantalum Steels.** R. Genders and R. Harrison (*Iron Steel Inst. Advance Copy*, 1936, Sept., 37 pp.).—The investigation described comprises a study of the constitution of the tantalum–iron system, an examination of the effect of tantalum and niobium on the structure and properties of carbon steels and of 4% nickel steel, and the development of tantalum as an alloy-steel element in nitriding steels and tool steels. The tantalum–iron system contains two eutectics formed by the compound Fe_2Ta with δ-iron and with tantalum at compositions of approximately 20% and 80% of tantalum, respectively. Below a tantalum content of 6.5% the δ solid solution is resolved, on cooling, into a eutectoid of γ-iron and Fe_2Ta. The solubility in γ-iron decreases with decrease in temperature to the γ-iron $\rightarrow$ α-iron inversion. The solubility of Fe_2Ta in α-iron is small. Tantalum–niobium mild steels conform metallographically with the main features of the pure alloys. The effect of tantalum is to decompose iron carbide, and with excess of tantalum the carbon steels consist essentially of iron–tantalum alloy with tantalum carbide, a compound which is insoluble and inert to heat-treatment. Tantalum–iron alloys nitride readily in dissociated ammonia at 500° C. and give deep penetration with increase in hardness. Extremely high hardness of the order obtainable in commercial nitriding steels is attained, together with deep penetration, by the addition of aluminium to tantalum steels. The reaction between tantalum and iron carbide provides a means of producing steels containing included carbide particles by the use of a high-carbon basis material, such as pig iron. By melting ferro-tantalum in contact with carbon, a product is obtained from which the carbide may be isolated by chemical means for use as an abrasive or sintered cutting material.—S. G.

***Investigations on Zinc–Aluminium Alloys with German Electrolytic Zinc as the Basis Metal and Copper, Magnesium, Nickel, Lithium, and Lead as Addition Metals.** W. Guertler, F. Kleweta, W. Claus, and E. Rickertsen (*Z. Metallkunde*, 1936, **28**, (5), 107–116 ; (6), 178–179).—Alloys made of German electrolytic zinc (99.98%) and 4% aluminium with and without additions of one or

more of the following: magnesium (0·04 and 0·1), lithium (0·03), copper (0·4 or 2·5), nickel (0·2), lead (0·5%) were cast in sand or chill moulds and their mechanical, ageing, and corrosion-resistant properties examined in the cast state and after rolling; the results are given in a series of tables and briefly discussed. The elongation of cast 4% aluminium–zinc alloys is reduced by additions of magnesium, but this defect is overcome by adding copper. Even traces of lithium reduce the tensile strength, but lithium and magnesium together are not so deleterious as either metal separately. Small quantities of nickel have no effect on the mechanical properties of castings, but if lead is also added the alloy becomes brittle and quite useless. The best alloy for rolling is that containing copper 0·4 and magnesium 0·04%. Ageing tests at 100° C. in air or in air saturated with steam show that none of the addition metals has any effect on the behaviour of the cast alloys, but that copper + magnesium prevent deterioration of the properties of rolled alloys, while lithium and lead cause a rapid breakdown of the alloys under these conditions. The presence of nickel, lithium, or lead in any of the alloys results in severe corrosion in the alternate immersion test in sea-water, the salt-spray test, and the oxidizing salt test. In an appendix the mechanical properties of sand- and chill-cast and rolled alloys with (a) 4% aluminium and 0·4 and 2·5% copper, and (b) 0·5% aluminium and 2 and 3% copper are shown in tables.—A. R. P.

*The System Iron–Zinc. Jakob Schramm (*Z. Metallkunde*, 1936, **28**, (7), 203–207).—Alloys with up to 20% iron were prepared by special melting methods designed to overcome loss of zinc by volatilization and breakage of the crucible by the high expansion, and alloys with more than 20% iron were prepared by methods of powder metallurgy using carbonyl iron and powdered 15% iron–zinc alloy and eventually homogenizing the alloys by prolonged annealing at 750°–800° C. in evacuated sealed tubes. The system was examined by X-ray, thermal and magnetic analysis, and by micrography. Four phases are stable at room temperature, *viz.*: η (hexagonal zinc-rich solid solution), δ (hexagonal, so-called $FeZn_7$), Γ (cubic, so-called $FeZn_3$ with 52 atoms in the unit cell), γ- and α-iron-rich solid solutions. The solubility of iron in solid zinc is less than 0·03% at the eutectic temperature and the eutectic point is 0·09% iron, 419·4° C. The homogeneous δ-field extends from 6·3 to 11·5% iron at 20° C. and from 5·8 to 11·5% iron at 419° C. The solidus extends in a smooth curve concave to the axis of composition from 419·4° C. at 5·8% iron to the peritectic horizontal at 668° C., 11·5% iron; this horizontal terminates at 20% iron (boundary of the (Γ + δ)-field), after which the solidus again rises in a smooth concave curve to meet the peritectic horizontal at 780° C., 27% iron (boundary of the homogeneous Γ-phase). The boundary between the (γ + Γ) and γ-fields is a straight line joining 54% iron, 780° C. with 73% iron, 623° C. The eutectoid horizontal at 623° C. extends from 80 to 27% iron, and the solid solubility of zinc in iron decreases from 20% at this temperature to 10% at 450° C. and to about 8% at 20° C. The (α + γ)-field is bounded by concave lines joining 900° C. 100% iron to the 20 and 27% iron points on the eutectoid horizontal. The composition of the δ-phase is not exactly $FeZn_7$ and that of the Γ-phase is neither $FeZn_3$ nor Fe_3Zn_{10}; no alternatives are suggested.—A. R. P.

*Cold Deformation and Recovery of Alloys with an Ordered Atomic Distribution. O. Dahl (*Z. Metallkunde*, 1936, **28**, (5), 133–138).—Curves are given showing the effect of cold-work on the tensile strength and electrical resistance of alloys of the type Ni_3Fe, Ni_3Mn, and $AuCu_3$ in the quenched state (random atomic distribution) and in the tempered state (ordered atomic distribution). These show that cold-working of the tempered alloys leads to the destruction of the ordered atomic distribution; this, however, is not due primarily to work-hardening, since in the case of Ni_3Mn and $AuCu_3$ subsequent annealing at temperatures below the recrystallization temperature restores the super-

structure in the X-ray photograms without removing the work-hardness. In these alloys, therefore, the peculiar properties produced by the superstructure can be combined with the enhanced strength produced by work-hardening. In contrast with the case of precipitation-hardening, the establishment of an ordered structure is not accelerated by prior cold-work. In the case of iron-nickel alloys cold-working the tempered alloys completely removes the drop in electrical resistance produced by the tempering and restores the resistance of the original quenched alloy ; subsequent annealing below the recrystallization temperature does not result in a further fall in resistance, but improves the tensile strength. Somewhat similar effects are observed with Ni_3Mn and $NiAu_3$, but neither of these alloys undergoes an increase in specific resistance in the quenched state after cold-working such as occurs with Ni_3Fe. Much further work is considered to be necessary before a satisfactory explanation of these phenomena can be given.—A. R. P.

*The Heat Content and Heat of Formation of Molten Alloys. Hans Otto von Samson-Himmelstjerna (*Z. Metallkunde*, 1936, 28, (7), 197–202).—A simple method is described by the aid of which the heat contents of lead–bismuth alloys at 400°, 500°, and 600° C., tin–bismuth, lead–tin, and lead–cadmium alloys at 500° C., lead–silver alloys at 1000° C., and lead–tin–bismuth alloys at 500° C. were determined. From the results obtained the heats of alloying have been calculated, and are shown graphically ; the maximum values are at 500° C. : lead–bismuth + 1000, bismuth–tin + 530, lead–tin − 250, lead–cadmium − 480 ; at 1000° C. : lead–silver − 800 grm.-cal. per grm.-atom. The heats of formation of solid silver–zinc and copper–zinc alloys lie on two straight lines which intersect at compositions corresponding to Ag_2Zn_3 and Cu_2Zn_3. The heats of formation of liquid alloys have been calculated from the heat contents of molten alloys at 1000° C. and the heats of formation of the solid alloys ; the results show that the compounds exist in the liquid state but are strongly dissociated unless an excess of either component is present. The heats of alloying copper–nickel and iron–nickel alloys at 1500° and 1600° C. vary only slightly from the heats of formation of the corresponding solid solutions.—A. R. P.

*Properties of Metallic Solutions. W. K. Ssementschenko (*Acta Physico-chimica U.R.S.S.*, 1935, 3, (5), 749–752 ; *Sci. Abs.*, 1936, [A], 39, 238).—[In English.] The possible chemical interactions in metallic solutions are simpler than those in dielectric solutions and the interatomic forces are more powerful and more homogeneous. A study of metallic solutions is undertaken in order to examine in a simple manner the general relationships of the dissolved state. The influence of the solute on the surface tension is determined by the difference in the values, termed " generalized moments," which are given by the expression $m = \epsilon z/r$, where ϵ is 4·77 × 10^{-10}, z is the valency of the ion, and r is the radius of the ion ; the ultimate value of the surface activity G is given by $G = RT\delta/1000 \times e^{\gamma(m_0 - m_1)}$, where γ is a constant depending on the properties of the solvent and the temperature, and m_0 and m_1 are generalized moments of the solvent and the solute. From measurements on a number of amalgams, it is shown that the physico-chemical properties of a metal may be characterized by its generalized moments.—S. G.

*On Gerlach's Thermomagnetic Electromotive Force in Some Ferromagnetic Alloys. Norie Yamanaka (*Sci. Rep. Tôhoku Imp. Univ.*, 1936, [i], 25, (2), 174–183).—[In English.] Y. found that the thermomagnetic e.m.f., discovered by W. Gerlach (*Met. Abs.* (*J. Inst. Metals*), 1931, 47, 197), appears not only in nickel and iron but also in other ferromagnetic alloys. Its dependence on the magnetic field and on the temperature gradient is fully investigated.—S. G.

*Treatment in a Temperature Gradient. —— (*Metallurgist* (Suppt. to *Engineer*), 1936, 10, 133–134).—A review of work by G. Tammann and W. Boehme, *Z. anorg. Chem.*, 1935, 226, 87 ; see *Met. Abs.*, this vol., p. 116.—L. O.

III.—STRUCTURE

(Metallography; Macrography; Crystal Structure.)

(Continued from pp. 357–361.)

Metallographic Applications of Electron Beams and Their Physical Basis. I. R. Piontelli (*Metallurgia italiana*, 1935, **27**, (12), 817–825; *C.Abs.*, 1936, **30**, 4390).—First of a series of articles on electronic waves. The theory of wave mechanics is briefly reviewed, and the electron microscope and its use are described.—S. G.

*On the Anodic Behaviour of Copper in Aqueous Solutions of Orthophosphoric Acid. P. A. Jacquet (*Trans. Electrochem. Soc.*, 1936, **69**, 629–650; discussion, 651–655).—See *Met. Abs.*, this vol., p. 117.—S. G.

*The Recrystallization Diagram of Magnesium. (Feldman.) See p. 386.

Industrial Applications of X-Ray Diffraction Analysis. Victor Hicks (*Instruments*, 1936, **9**, (5), 133–136).—S. G.

*The Structure of Some Metallic Deposits on a Copper Single Crystal as Determined by Electron Diffraction. William Cochrane (*Proc. Phys. Soc.*, 1936, **48**, (5), 723–735).—Nickel, copper, zinc, cadmium, silver, chromium, and cobalt were deposited electrolytically on etched copper single crystals, and the structures of the deposits were found by electron diffraction. At small current densities the layers are oriented except in the case of zinc and cadmium. The nickel and cobalt deposits give patterns containing additional spots, lines, and irrational spots. It is shown that these are accounted for by assuming the occurrence of repeated twinning on (111) planes, the additional spots being due to twinned lattices and the lines due to twin planes. The twin planes must be considered separately and not simply as part of the lattices on either side of them. The twin sheets of lattice thus formed give rise to the irrational spots observed. Finally, a discussion is given of the factors determining the orientation of a layer of metal on the copper crystal.—S. G.

*The Atomic Factor of Zinc. Cecilia Mossin Kotin and José Losada (*Anales soc. españ. fis. quim.*, 1935, **33**, 597–601; *C. Abs.*, 1936, **30**, 347).—The scattering factor of zinc is determined, the first obtained from an element belonging to the hexagonal system. The photometric method was used to measure the intensities of the reflections, according to which a curve of relative values is drawn. Intensity of the (101) reflection of zinc is compared to the intensity of the (200) reflection of NaCl, and for $\sin \theta/\lambda = 0\cdot234$, $f_{Zn} = 31\cdot0$, which permitted the curve of the experimental values to be drawn. Comparison of the experimental with the theoretical curve shows a greater slope for the first, and two undulations not found in the latter.—S. G.

*On the Energy States of Valency Electrons in Some Metals. I.—The Crystal Energy Levels of Valency Electrons in Zinc (1). Mituru Satô (*Kinzoku no Kenkyu* (*J. Study Metals*), 1936, **13**, (3), 92–98).—[In Japanese.] From the analysis of *L*-non-diagram lines α', α'', β', β'' and of Osgood's lines the crystal energy levels of valency electrons in zinc were sought and 6 levels were determined. The energy distances from *K*-level were found to be 710·920, 711·040, 711·280, 711·297, 711·335, and 711·859 in Rydberg units. The wave-lengths corresponding to these values of $\frac{\nu}{R}$ were compared with the curves of *K*-absorption edges for zinc and zinc oxide due to Barnes (*Phys. Rev.*, 1933, [ii], **44**, 141), and some other levels, the existence of which was still in doubt, were determined.—S. G.

*On the Energy States of Valency Electrons in Some Metals. I.—The Absolute Values of Some X-Ray Levels of Zinc (2). Mituru Satô (*Sci. Rep. Tôhoku Imp. Univ.*, 1936, [i], **25**, (2), 197–201 (in English); and *Kinzoku no Kenkyu* (*J. Study Metals*), 1936, **13**, (4), 142–145 (in Japanese)).—From the

L-non-diagram lines and *K*-absorption edges for the solid and for the vapour of zinc, the absolute value of the *K*-term was determined and found to be $K = 711\cdot880$ Rydberg units ; consequently, the absolute values of the crystal levels of the valency electrons in zinc were determined and found to be $E_1 = 0\cdot960$, $E_2 = 0\cdot840$, $E_3 = 0\cdot600$, $E_4 = 0\cdot581$, $E_5 = 0\cdot545$, and $E_6 = 0\cdot021$, all expressed in the crystal Rydberg unit.—S. G.

Simple Numerical Relationships in Binary Eutectic Mixtures. D. Stockdale (*Trans. Faraday Soc.*, 1936, **32**, (9), 1365–1369).—S. has recently shown that there is a reasonable probability that the constituents of metal eutectics are present in a comparatively simple ratio ; in the present paper he shows that this is also true for eutectics of salt mixtures with a common ion as well as for many eutectics between organic compounds.—A. R. P.

*****Theoretical Diffraction Patterns Corresponding to Some Simple Types of Molecular Arrangement in Liquids.** J. A. Prins and H. Petersen (*Physica*, 1936, **3**, (3), 147–153).—[In English.] Theoretical diffraction patterns are computed for liquid arrangements corresponding to the following structures : *A* cubic and hexagonal close-packed, *B* body-centred cubic, *C* simple cubic, and *D* diamond structure. The co-ordination numbers of these structures are, respectively, for *A* 12 ; for *B* 8 ; for *C* 6 ; for *D* 4. Experimental confirmation is found by taking for : *A* inert gases and mercury, *B* alkali metals, C antimony, *D* silica and water. The method of " smearing out " an ideal structure (crystal lattice) to get the corresponding liquid arrangement is taken from a one-dimensional model.—S. G.

*****X-Ray Investigation of the Mechanism of Transformation of Face-Centred Cubic into the Hexagonal Close-Packed Lattice.** Zenji Nishiyama (*Kinzoku no Kenkyu* (*J. Study Metals*), 1936, **13**, (7), 300–310).—[In Japanese.] The mechanism of transformation of face-centred cubic (γ) into hexagonal close-packed (h) lattice was studied for an alloy of cobalt containing 30% nickel. It was found that the change takes place in such a manner that $\gamma(111)//h$ (0001) and $\gamma[\bar{2}11]//h$ $[1\bar{1}00]$.—S. G.

The Thermal Theory of Cathodic Sputtering. II.—The Elementary Process. N. D. Morgulis (*Zhurnal experimentalnoy i teoreticheskoy Fiziki* (*J. Exper. and Theoret. Physics*), 1935, **5**, 588–594).—Cf. *Met. Abs.*, 1935, **2**, 101. The theory of Hippel is further developed.—S. G.

IV.—CORROSION

*****Contribution to the Problem of the Formation of Protective Films on Aluminium Containing Magnesium.** Werner Geller (*Z. Metallkunde*, 1936, **28**, (7), 192–194).—The resistance of aluminium and its alloys to corrosion depends chiefly on the formation of a passive film and its continuous renewal during the slow dissolution of the metal. From determinations of the rate of dissolution of $99\cdot98\%$ aluminium with additions of $0\cdot05$–1% of magnesium in dilute reversed *aqua regia* and in $0\cdot001$, $0\cdot01$, and 20% sodium hydroxide solution, it is shown that magnesium increases the resistance of aluminium to attack by acids and very dilute alkalis, but at alkali concentrations above a certain critical value and above a critical temperature it produces rupture of the passive film and prevents healing so that a violent attack on the metal takes place.—A. R. P.

*****Oxide Film of Alloys Containing Small Percentages of Aluminium.** Ichiro Iitaka and Shizuo Miyake (*Proc. Imp. Acad.* (*Tokyo*), 1935, **11**, (7), 256–257).—[In English.] —S. G.

†**The Corrosion of Hardenable Aluminium and Magnesium Alloys.** E. Söhnchen (*Korrosion u. Metallschutz*, 1936, **12**, (3), 41–46).—A lecture delivered

at the Winter Meeting of the Foundry Institute of the Technische Hochschule, Aachen. Recent work is reviewed.—A. R. P.

Corrosion of Precipitation-Hardened Alloys by Acids. ——(*Metallurgist* (Suppt. to *Engineer*), 1936, **10**, 143–144).—A brief, critical summary of papers by G. Tammann and W. Boehme, *Z. anorg. Chem.*, 1935, **226**, 82, and E. Söhnchen, *Korrosion u. Metallschutz*, 1936, **12**, 41 ; see *Met. Abs.*, this vol., p. 120, and preceding abstract.—L. A. O.

Corrosion. X.—Copper Alloys : Constitution and Properties. —— (*Silk and Rayon*, 1935, **9**, 582, 584, 589).—The nature and properties of the brasses are discussed, with particular reference to corrosion.—S. G.

*Corrosion Tests on Tinplate. G. Gire (*15me. Congr. chim. indust. (Bruxelles, 1935*), 1936, 783–800 ; *C. Abs.*, 1936, **30**, 5547).—A study of the attack of various grades of tinplate by acetic acid solutions of various concentrations. · For each grade of tinplate the solution of tin and iron as a function of time was measured on the same sample ; this permitted the drawing of curves which, if the weight of the tin coating was taken into consideration, showed the relative resistance of the samples to this type of corrosion. Similar tests were carried out by producing electrolytic sulphurization of the sample by electrolysis in a sodium sulphide solution with the tinplate to be corroded as anode ; from the total sulphur deposited and its distribution as SnS and FeS, corrosion curves were obtained which characterized the resistance of the various samples to this type of corrosion. The results obtained in the two series were absolutely comparable and brought out the primary importance of the condition of the tinplate in its resistance to corrosion. Microscopic examination of the samples confirmed this.—S. G.

Facts About Dye Vats. G. H. Pearson (*Textile Mercury*, 1935, **92**, (2412), 509. **Corrosion-Resisting Dye Vats.** G. H. Pearson (*Textile Mercury*, 1935, **93**, (2420), 129 ; *J. Textile Inst.*, 1935, **26**, A528).—The advantages of stainless steel and other resistant metals over wood in the construction of dye vats is stressed and details are given of suitable thicknesses and methods of bracing and jointing.—S. G.

Diseases of Steels and Other Metals and Their Prevention. Robert S. Williams (*Amer. Dyestuff Reporter*, 1935, **24**, (13), 369–373 ; *J. Textile Inst.*, 1935, **26**, A528).—A general discussion of the causes and prevention of corrosion and the corrosion-resistance of various metals and alloys suitable for dyeing machinery.—S. G.

*Corrosion from Products of Combustion of Gas. III.—Tube Experiments (Contd.). —— (*Light Metals Rev.*, 1936, **2**, (14), 236–237).—Cf. *Met. Abs.*, 1935, **2**, 693. From 36th Report of the Joint Research Committee of the Institution of Gas Engineers and Leeds University, November 1935.—S. G.

Report of the Corrosion Committee [of the Electrochemical Society]. —— (*Trans. Electrochem. Soc.*, 1936, **69**, 11–18).—A review of the literature for the year 1935.—S. G.

The Aims and Work of the Central Corrosion Committee. W. F. J. M. Krul (*Chem. Weekblad*, 1936, **33**, (22), 331).—Read before the Delft Chemical Society. Describes the work of the Committee, which has published the following papers : " The Electrochemical Theory of Corrosion," by H. van der Veen ; " First Report of Corrosion Committee II for the Study of the Corrosion of Pipes by Soil " ; " Second Report of Corrosion Committee II for the Study of the Corrosion of Pipes by Soil : Corrosion of Tubes " ; " Report of Corrosion Committee III for the Study of the Corrosion of Cables by Soils."—L. A. O.

†Deformation, Heat-Treatment, Solubility [of Non-Ferrous Metals]. First Report of the Committee on Non-Ferrous Metals (*Korrosion u. Metallschutz*, 1936, **12**, (1/2), 2–28).—From a critical review of recent work on the corrosion of non-ferrous metals, especially zinc–copper and nickel–copper alloys, and

the effect thereon of heat and mechanical treatment the following conclusions are reached : The solubility of non-ferrous alloys in acids is determined by the structure and by the previous mechanical and thermal history. The solubility relations of cold-worked, single-phase copper alloys containing nickel or zinc follow Heyn's law and the course of the solubility curve is not affected by the degree of drawing or by regular intermediate anneals. From the position of the solubility curve, and making certain assumptions, conclusions can be reached as to the method of manufacture of the material. The metals are more soluble in the hard-drawn state than after annealing, but the effect of the size of the recrystallized grain varies in different cases. The transition from the elastic to the plastic state produces no change in the solubility. The conductivity of the alloys increases during the course of dissolution, whilst the solution potential is decreased due to preferential dissolution of the zinc. Increasing cold-work increases the solution potential of the less noble constituent. A *bibliography* of 118 references is appended.

—A. R. P.

*Corrosion of [Metals] after Permanent and Elastic Deformation. W. O. Kroenig and A. J. Boulitschewa (*Korrosion u. Metallschutz*, 1936, **12**, (4), 73–81).—Corrosion tests on aluminium, Duralumin, brass, and iron subjected to stresses below the limit of proportionality while in the corroding medium show that the electrode potential of the metal becomes less noble with increasing stress, *i.e.* that the rate of corrosion increases as the internal stress is increased, sometimes as much as tenfold. Under elastic stresses iron, brass, and, especially, Duralumin display a tendency to intercrystalline corrosion which is not shown by the unstressed metal. Aluminium plastically deformed by rolling shows an electrode potential which decreases with increase in the degree of reduction, while the loss in weight by corrosion simultaneously increases.—A. R. P.

*[Observations] on the Course of Corrosion [of Metals] by Means of Contact Photographs. N. Goldowski (*Korrosion u. Metallschutz*, 1936, **12**, (5/6), 108–118).—The specimens used are thin sheets bent round and welded into the form of hollow cylinders, the test is carried out by rotating the cylinders in aerated sea-water for definite periods, and the course of corrosion is followed by taking contact prints which show up the perforations produced by corrosion. The necessary apparatus is described and illustrated. Qualitative information is afforded by the test on the questions of where and how corrosion occurs and the course it takes, *i.e.* whether it spreads out from certain points or whether new corrosion centres are being continuously formed. Quantitative results may be obtained by determining loss in weight and the changes which occur in the number and size of the perforations with the progress of corrosion. Tests on a number of metals have shown that two types of corrosion may occur : (*a*) characterized principally by increase in the number of corrosion centres according to an exponential law ; (*b*) characterized by an increase in the size of the corroded places according to a parabolic law. Examples of both are described and discussed.—A. R. P.

*On the Explanation of the " Positive Difference Effect." W. O. Kroenig and V. N. Uspenskaya (*Korrosion u. Metallschutz*, 1936, **12**, (5/6), 123–131).—When sheets of zinc and platinum are electrically connected and immersed in dilute acid the rate of evolution of hydrogen from the zinc is less than when the platinum is absent. From experiments on other couples and on 3 and 4 different metals in contact, it is shown that this so-called " positive difference effect " is not due to a change in the resistance of local elements in the less noble metal and cannot be explained by Akimov's theory of polyelectrode elements, but is due to ennoblement of the anode potential brought about by the increased anodic charge produced by coupling the metal with a new external cathode. This increase in anode potential is favoured by an increase in the ionic concen-

tration of the dissolving metal in the anodic regions produced by intensified dissolution of the anode.—A. R. P.

*On the Theory of Corrosion Phenomena. IV.—On the Application of the Theory of Local Elements to the Problem of Corrosion. W. J. Müller (*Korrosion u. Metallschutz*, 1936, **12**, (5/6), 132–138).—According to M.'s theory of coating passivity the resistance (r_p) in the pores of the film and the resistance (r_s) of the film itself may be calculated from the expressions $r_s = r \cdot C$ and $r_s = r(1 - C)$, where $r = r_s + r_p$ and $C = K'F/[K'F + K(F_0 - F)]$; F is the total surface covered by the film, ($F_0 - F$) the area of the pores, K' the specific conductivity of the substance forming the film, and K the conductivity of the electrolyte in the pores. The potential E of the corroded electrode is $E_{metal} - (E_{film} - E_{metal})C$, and at approximately constant rate of attack the mean current density of the local elements is $96{,}540 \ a/mt$, where a is the amount of hydrogen evolved or metal dissolved, m is the chemical equivalent of the hydrogen or metal, and t is the time in seconds. By the use of these expressions it is possible to explain all the phenomena of corrosion which cannot be explained by the simple local element theory. Thus, the resistance of the film on pure aluminium is very high and therefore the metal is little attacked in dilute acids, but if metallic impurities are included in the film its resistance decreases considerably, *e.g.* to $\frac{1}{1000}$ part of the normal resistance when the metal contains $0 \cdot 5\%$ of impurities. In concentrated acids the film which is normally 10^{-4} cm. thick is partly dissolved and the conductivity of the film increases considerably owing to the action of the embedded metal particles. Calculations based on a value of K of 10^{-1} ohm^{-1} show that the free pore space in dilute acids is of the order of 10^{-5} cm.^{2}/cm.^{2}. The extremely rapid increase in the rate of dissolution of impure aluminium with increasing concentration of acid is thus explained by a thousand-fold decrease in the thickness of the film and a ten-fold increase in the size of the pores. Similar explanations are given of phenomena observed in the dissolution of iron and zinc in acids.
—A. R. P.

*On the Influence of Oxygen on the Potential of Local Cathodes. M. Straumanis (*Korrosion u. Metallschutz*, 1936, **12**, (5/6), 148–154).—Local elements to which free access of oxygen is restricted have, in ordinary cases of corrosion, only a small e.m.f. which, however, increases rapidly when oxygen is allowed free access, owing to the potential of the hydrogen-charged cathodes being rendered more positive while that of the anode remains unchanged. This effect is due to the action $2H + O = H_2O$ which is accelerated to a greater or less extent by the cathode material, as shown by experiments on platinum, nickel, and iron. The current density–potential curve of a local cathode in a hydrogen atmosphere can be considered as an overvoltage curve; if, therefore, the potential becomes more positive by the introduction of oxygen, there must be a reduction in the overvoltage caused by the diffusion of oxygen. Hence, a minimum overvoltage of hydrogen does not exist and the occurrence of an overvoltage is connected with the presence of a finite current density, which is always present in local elements. Corrosion by uneven aeration can be explained on similar lines.—A. R. P.

†The Corrosion of Metals. A Review of Recent Work. T. P. Hoar (*Met. Ind.* (*Lond.*), 1936, **49**, (8), 177–203; (9), 207–212).—An excellent review of modern corrosion research. The composition, formation, breakdown, and repair of the primary oxide film on metals is discussed. The mechanism of attack in neutral electrolytes, the influence of oxygen and salt concentration, and the influence of corrosion products are clearly stated. Much work has been done recently on atmospheric corrosion and protective coatings. A *bibliography* of 140 references is given.—J. E. N.

Prevention of Corrosion by Additions to the Corroding Medium. Erich Rabald (*Chem. Fabrik*, 1936, **9**, (27/28), 310–311).—The nature and function of

inhibitors is discussed, with special reference to their use in acid pickling solutions.—A. R. P.

*Organic Inhibitors in Corrosion. Charles A. Mann (*Trans. Electrochem. Soc.*, 1936, **69**, 115–128 ; discussion, 128–129).—See *Met. Abs.*, this vol., p. 205.—S. G.

Inhibitors—Safe and Dangerous. Ulick R. Evans (*Trans. Electrochem. Soc.*, 1936, **69**, 213–227 ; discussion, 227–231 ; and *Metal Cleaning and Finishing*, 1936, **8**, (5), 255–260 ; (6), 313–318).—See *Met. Abs.*, this vol., p. 121.—S. G.

The Electrochemical Mechanism of Corrosion. U. R. Evans (*Korrosion u. Metallschutz*, 1936, **12**, (5/6), 105–107).—The subject is discussed with especial reference to the nature of the corrosion of iron.—A. R. P.

The Modern Theory of Corrosion. W. W. Kittelberger (*Amer. Paint J.*, 1936, **20**, (June 29), 23–24, 26, 54, 56, 58 ; *C. Abs.*, 1936, **30**, 5547).—A brief discussion of the electrochemical theory of corrosion ; corrosion by direct chemical attack, in the absence of water and in the presence of water, and corrosion in which the dissolving metal displaces hydrogen from solution, with visible evolution of hydrogen and without visible evolution of hydrogen because the discharge potential of hydrogen on the cathode surfaces is greater than the potential of the dissolving metal. Anodic control and the use of chemical inhibitors are discussed.—S. G.

The Meaning and Mechanism of Metallic Corrosion. W. J. Müller (*Internat. Rohstoffwirtschaft*, 1936, **1**, (1)).—The importance of corrosion from the economic point of view, and its electrochemical aspects particularly with reference to the passivity phenomenon, is discussed.—L. A. O.

Corrosion. Henry G. Pike (*Modern Eng.*, 1936, **10**, (6), 284–286).—A popular account of the operation of electrode potential, differential aeration, and protective films.—H. W. G. H.

Modifications in the Standardized Apparatus for Corrosion Testing by Means of a Saline Mist. Jean Lucas (*15me. Congr. chim. indust. (Bruxelles, 1935)*, 1936, 1–5 ; *C. Abs.*, 1936, **30**, 5547).—A description of modifications that have been made in the design of the apparatus standardized by the (French) Committee on the Study of Corrosion of Metallurgical Products Required for Aeronautics. These have resulted in maintaining the volume and concentration of the saline bath constant, and in imposing on the saline mist in the testing box a definite path that places the test-pieces under more stable experimental conditions.—S. G.

*On the Influence of the Working Conditions on the Results of the Mylius Test.** W. Deisinger (*Aluminium*, 1936, **18**, (6), 249–252).—The effects of acid concentration, initial temperature, room temperature, heat insulation, and surface condition of the specimen on the results obtained in the Mylius test are described. The standard acid used contains 100 grm. of hydrogen chloride per litre ; a deviation of 1% in the concentration of the acid results in a deviation of $\pm$ 20% in the Mylius number (total increase in temperature divided by the time of reaction in seconds, *i.e.* ° C./second). Variations of $\pm$ 2° C. from the standard initial temperature (20° C.) result in deviations of $\pm$ 6% ; if the room temperature is 15° C. the results may be 9% low and if it is 20° C. as much as 32% high. With specimens covered with the usual oxide film the results are about 12% lower than with similar specimens from which the film has been removed by pickling. Under the best conditions the Mylius number is reproducible within $\pm$ 7·5%.—A. R. P.

*Contribution to the Problem of the Measurement of Corrosion in Metals— Experience with Tödt's Residual Current on Lead.** H. Nitschmann (*Schweiz. Arch. angew. Wiss. Tech.*, 1936, **2**, (4), 96–103).—After general remarks on corrosion measurement, Tödt's method is described. Results with lead are summarized and given a theoretical interpretation. They suggest the possibility of conditions in which the method may give accurate results.

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Tödt's determination is based on the assumption that the strength of the current in a local electrolytic cell on the surface of a metal in a corrosive medium is proportional to the number of metallic ions going into solution. It is confined to circumstances where oxygen is active but no gaseous hydrogen is evolved. In a final summary, N. discusses the limitations of the method.
—W. A. C. N.

Modern Microscope Technique in the Service of Corrosion Research. A. Kufferath (*Korrosion u. Metallschutz*, 1936, **12**, (7), 171–175).—Some types of modern microscopes are described, and photomicrographs of corrosion phenomena on galvanized iron, brass, Duralumin, and tinplate are shown and discussed.—A. R. P.

Standard Corrosion Tests. —— (*Metallurgist* (Suppt. to *Engineer*), 1936, **10**, 130–131).—A critical review of paper by O. Bauer, *Z. Metallkunde*, 1936, **28**, (2), 25 ; see *Met. Abs.*, this vol., p. 159.—L. A. O.

V.—PROTECTION

(Continued from pp. 363–366.)

Modern Electrochemical Processes for Protecting [Aluminium] Metal Surfaces and Their Physicochemical Principles. Hellmut Fischer (*Angew. Chem.*, 1936, **49**, (30), 493–498 ; and *Light Metals Research*, 1936, **5**, (2), 28–43).—A lecture. Methods of plating and anodizing aluminium are critically reviewed and their principles explained.—A. R. P.

*On the M.B.V. Treatment of Age-Hardened Aluminium Alloys [Pantal]. W. Geller (*Aluminium*, 1936, **18**, (6), 252).—Direct M.B.V. treatment of age-hardened Pantal sheets affords little or no protection against salt-spray corrosion ; adequate protection is obtained, however, if the metal is first pickled for 2 minutes in 20% sodium hydroxide solution to remove the oxide film produced by the heat-treatment processes, then given the M.B.V. treatment, and finally boiled for 10 minutes in water.—A. R. P.

Improved Coatings for Duralumin. Herbert Chase (*Aero Digest*, 1936, **28**, 40 ; *C. Abs.*, 1936, **30**, 5819).—A brief *résumé* of the results of some tests on anodic film, paint, lacquer, and pigment coatings on Duralumin. Specimens remained in 20% salt-spray without failure for more than 4700 hrs. The best coating is a paint vehicle with aluminium powder.—S. G.

Tinning as a Protective Means. A. D. Tikhonov and N. I. Kovalev (*Voprosui Pitaniya*, 1935, **4**, (6), 88–91 ; *C. Abs.*, 1936, **30**, 5165).—The temperature coeff. for the solubility of tin is 41 from 15° to 70°, while for iron it is 28·5 and for copper it is almost unity. The e.m.f.–temperature relation of the systems tin–iron and tin–copper are also unfavourable.—S. G.

*A Study of the Origin of Porosity in the Tin Coating of Tinplate. A. W. Hothersall and J. C. Prytherch (*J. Iron Steel Inst.*, 1936, **133**, 205–219 ; discussion, 220–224 ; and *Tech. Publ. Internat. Tin Res. Develop. Council, Series A*, 1936, (38), 15 pp.).—See *Met. Abs.*, this vol., p. 160.—S. G.

*Influence of Working Conditions on the Porosity of Tinplate. W. E. Hoare (*Metallurgist* (Suppt. to *Engineer*), 1936, **10**, 115–116).—A review abstract and discussion of a paper by Fritz Peter and Georges Le Gal, *Arch. Eisenhüttenwesen*, 1935–1936, **9**, 285–287 ; see *Met. Abs.*, this vol., p. 10.
—L. A. O.

*Methods of Detinning Tinplate for Examination of the Thickness and Continuity of the Alloy Layer. A. W. Hothersall and W. N. Bradshaw (*J. Iron Steel Inst.*, 1936, **133**, 225–234 ; discussion, 235–237 ; and *Tech. Publ. Internat. Tin Res. Develop. Council, Series A*, 1936, (37), 10 pp.).—See *Met. Abs.*, this vol., p. 160.—S. G.

Corrosion After Pickling Major Source of Galvanizer's Dross. Wallace G. Imhoff (*Iron Age*, 1936, **138**, (6), 34–37, 95–97).—See also *Met. Abs.*, this vol., pp. 43 and 122. Describes the reducing action of molten zinc in galvanizing baths on roll scale. There is a marked resistance of roll scale to the action of molten zinc at ordinary galvanizing bath temperatures. The results of an experimental investigation into this action showed : (1) that corrosion after pickling is a major source of iron to form galvanizer's dross ; (2) that material that has not been fully pickled must remain in the bath longer, and that the bath temperature must be higher to break down the scale and iron oxides, and give a perfect coating ; (3) that dross crystals were produced in the tests, showing conclusively that the iron from corrosion is the same as that in the dross crystals.—J. H. W.

Alloys in the Zinc Bath. G. A. Brayton (*J. Amer. Zinc Inst.*, 1936, **17**, 87–91 ; discussion, 91–93 ; and *Amer. Metal Market*, 1936, **43**, (81), 3, 6 ; and (summary) *Met. Ind.* (*N.Y.*), 1936, **34**, (8) 336–337).—Lead and iron, unwanted impurities, are both detrimental to the working of the bath and to the adherence and corrosion-resistance of the coating. Tin is sometimes added to the bath and, in amounts of 1–2%, increases workability of the bath, uniformity and adherence of the coating. Antimony reduces the corrosion-resistance and adherence of the coating. Antimony, tin, aluminium, and cadmium, used in dip galvanizing, produce very attractive spangles. Aluminium produces black dirt spots in sheet galvanizing. Additions do not materially reduce the dross production.—H. W. G. H.

*The Action of Zinc on Iron and on Ordinary and Special Steels. I. Musatti and A. La Falce (*Rev. Mét.*, 1936, **33**, (6), 362–370).—See *Met. Abs.*, this vol., p. 364.—S. G.

Testing for Adherence of Galvanized Coatings. B. P. Finkbone (*J. Amer. Zinc Inst.*, 1936, **17**, 76–79 ; discussion, 79–80 ; and *Amer. Metal Market*, 1936, **43**, (79), 6 ; (80), 3).—Attempts to cover the question of adherence in various specifications are reviewed, together with some suggested workshop and laboratory tests. It is concluded that no completely satisfactory test is yet available. Such a test should take into consideration : (1) severity of forming for a given weight of coating ; (2) elongation of material to be expected from the forming to be done ; (3) speed of deformation ; (4) variation in weight of coating ; and its development would only be made possible by co-operation of producers and consumers.—H. W. G. H.

*[Testing the] Zinc Coating on Galvanized Iron. (Nash.) See p. 409.

Sweating of [Galvanized] Sheets in Transit and Storage. G. C. Bartells (*J. Amer. Zinc Inst.*, 1936, **17**, 98–102 ; discussion, 102–105).—A non-technical plea for greater care in packing and storing galvanized sheets. Many cases are quoted of the extremely poor behaviour in service of sheets which had been stored in piles horizontally, so that sweating and corrosion of the coating by the moisture had taken place before the sheets had been put to use. It is vigorously emphasized that galvanized sheets should be stored vertically in such a way that there is free circulation of air between them.—H. W. G. H.

Treatment of Galvanized Sheets for Painting. J. L. Schueler (*J. Amer. Zinc Inst.*, 1936, **17**, 93–96 ; discussion, 96–98 ; also *Amer. Metal Market*, 1936, **43**, (78), 5, 6 ; *Met. Ind.* (*N.Y.*), 1936, **34**, (6), 215–216 ; and *Metal Cleaning and Finishing*, 1936, **8**, (6), 339–342).—The matte-surfaced, non-spangled galvannealed sheet can be painted without special treatment, but the ordinary, smooth, spangled sheet must be treated in one of the following ways (in order of recommendation) : (1) atmospheric " weathering " ; (2) scouring with fine abrasive ; (3) chemical etching with copper sulphate, antimony chloride, or (with great care) acids.—H. W. G. H.

†Protective Finishes on Zinc. S. W. K. Morgan and L. A. J. Lodder (*J. Electroplaters' Tech. Soc.*, 1936, **11**, 87–100 ; and *Aluminium and Non-Ferrous Rev.*, 1936, **1**, (6), 232–237).—See *Met. Abs.*, this vol., p. 365.—J. C. C.

Critical Considerations on Metal Coatings. J. Biert (*Schweiz. Arch. angew. Wiss. Tech.*, 1936, **2**, (1), 22–28).—A summary of the various methods of producing metal coverings—electrolysis, chemical deposition, spraying, high-temperature diffusion—followed by a discussion of their several advantages and their separate applications in the case of individual metals.
—W. A. C. N.

*The Density of Sprayed Metal Coatings. Theo Everts (*Z. Metallkunde*, 1936, **28**, (6), 143–150; and (summary) *Light Metals Research*, 1936, **5**, (1), 5–7).—By the term " density " as applied to spray coatings is meant the resistance of the coating to penetration by a gas or liquid. The " density number " (D) represents the number of seconds required to spray a layer 0·5 mm. thick on 1 cm.² of surface by 1 litre of gas at 15° C. and 1 atmosphere pressure. The values of D for copper, aluminium, zinc, lead, Monel metal, iron, and V2A steel are shown graphically as functions of the film thickness, distance of the pistol from the work, oxygen pressure, hydrogen pressure, air pressure, and rate of feed of the wire to the pistol. The minimum thickness at which the deposited layer just shows small pores when removed from the work and held to the light varies with the metal and spraying conditions; for a spray distance of 20 cm. and the optimum conditions as regards oxygen, hydrogen, and air pressures, rate of feed, and thickness of wire the minimum " sound " layer is for zinc 0·09, lead 0·13, copper 0·18, aluminium, Monel metal, and iron 0·22, and V2A steel 0·26 mm. Annealing, burnishing, polishing, and hammering the sprayed deposits results in considerable closing-up of the pores, and this improves the resistance to corrosion and protective properties of the films.—A. R. P.

Making Airplanes Weatherproof.—III. W. Hardy (*Paint Manuf.*, 1936, **6**, (6), 173–175, 182; *C. Abs.*, 1936, **30**, 5546).—A discussion of the cleaning and preparation of the surface to receive the protective coating. Anodic pickling of steel with a bath containing 1 part sulphuric acid, 2 parts water, and 3 oz. (75 grm.) potassium bichromate per gall. of acid bath is effected by making the part to be cleaned the anode, lead or graphite cathodes being used with a current density of approx. 100 amp. per sq. ft. of surface. This treatment makes steel, subsequently to be electroplated with cadmium or zinc, immune from hydrogen embrittlement. Cleansing processes include : (1) washing in hot water and drying ; (2) removal of grease by organic solvents, either liquid or vapour ; (3) a hot caustic solution followed by washing and drying ; (4) scratch-brushing, scrubbing with pumice powder or polishing with emery, and (5) shot-blasting. Anodic oxidation is confined to aluminium and aluminium-rich alloys. The surfaces of magnesium-rich alloys are of a peculiar greasy nature. To permit adherence of organic protective materials these alloys must be pickled in an acid or alkaline bath and then treated in a chromate bath. Metal coatings on steel are discussed ; none of the processes is satisfactory for all steel parts. The final treatments for aluminium and magnesium alloys are discussed.—S. G.

VI.—ELECTRODEPOSITION

*Aluminium-Plating Nickelin. N. N. Gratzianskii (*Mem. Inst. Chem. Ukrain. Acad. Sci.*, 1935, **2**, 141–148 ; *C. Abs.*, 1936, **30**, 5504).—[In Ukrainian.] Nickelin is aluminium plated by electrodeposition from fused $AlCl_3$–NaCl (1 amp./dm.² at 250° C.), and a surface oxide layer is formed on the aluminium. The product so obtained has a lower conductivity than unplated Nickelin, and is 4–6 times as resistant to oxidation at higher temperatures.—S. G.

*Aluminium Plating from Organic Baths. R. D. Blue and F. C. Mathers (*Trans. Electrochem. Soc.*, 1936, **69**, 519–527; discussion, 533–534; also *Met. Ind.* (*Lond.*), 1936, **49**, (5), 115–117; and (summary) *Light Metals Research*, 1936, **5**, (1), 18–19).—See *Met. Abs.*, this vol., p. 208.—S. G.

*Electrodeposition of Aluminium Alloys. R. D. Blue and F. C. Mathers (*Trans. Electrochem. Soc.*, 1936, **69**, 529–533; discussion, 533–534).—See *Met. Abs.*, this vol., p. 208.—S. G.

*On the Critical Current Density in the Deposition of Chromium. N. D. Biriukoff (*Korrosion u. Metallschutz*, 1936, **12**, (7), 165–171).—In the electrodeposition of chromium from chromic acid baths there is a critical current density below which no deposition occurs; this critical value is increased with rise in temperature owing to the greater rapidity with which the chromous oxide layer on the cathode is reoxidized. Addition of potassium dichromate, potassium bisulphate, potassium sulphate, chromic sulphate, sulphuric acid, or chromic hydroxide has no effect on the critical current density at any temperature, but lead chromate reduces it and chromic chromate increases it rapidly if this is produced by melting chromic acid or by boiling aqueous chromic acid with chromic hydroxide. In all cases a steep increase in critical current density occurs if the solution is heated above 25°–27° C.—A. R. P.

Behaviour of Inner Surfaces of Chromium-Plated and Nitride-Hardened Gun Barrels. O. Macchia (*Industria meccanica*, 1934, **16**, 180–182, 267–269; *C. Abs.*, 1936, **30**, 5541).—Neither chromium plating nor nitride hardening possesses advantages over the usual treatment.—S. G.

Determination of Trivalent Chromium in Chromium Plating Baths.—II. (Young.) See p. 409.

*Theory and Practice of Chromium Plating.—I–II. N. D. Biriukov, S. P. Makarieva, and A. A. Timochin (*Korrosion u. Metallschutz*, 1935, **11**, (8), 172–179; (9), 193–201).—See *Met. Abs.*, 1935, **2**, 62.—S. G.

*Theory and Practice of Chromium Plating.—III–IV. N. D. Biriukov and S. P. Makarieva (*Korrosion u. Metallschutz*, 1935, **11**, (12), 265–278).—See *Met. Abs.*, 1935, **2**, 235.—S. G.

*Alkaline Plating Baths Containing Ethanolamines. III.—Cobalt Plating from Triethanolamine Solutions. C. J. Brockman and J. P. Nowlen (*Trans. Electrochem. Soc.*, 1936, **69**, 550–551; discussion, 556).—See *Met. Abs.*, this vol., p. 124.—S. G.

*Alkaline Plating Baths Containing Ethanolamines. I.—Copper Plating from Triethanolamine Solutions. C. J. Brockman and A. L. Brewer (*Trans. Electrochem. Soc.*, 1936, **69**, 535–540; discussion, 556).—See *Met. Abs.*, this vol., p. 124.—S. G.

*The Electrodeposition of Manganese from Aqueous Solutions. I.—Chloride Electrolytes. Harold H. Oaks and W. E. Bradt (*Trans. Electrochem. Soc.*, 1936, **69**, 567–583; discussion, 583–584).—See *Met. Abs.*, this vol., p. 162.—S. G.

*The Electrodeposition of Molybdenum from Aqueous Solutions. Wm. P. Price and O. W. Brown (*Electrochem. Soc. Preprint*, 1936, Oct., 67–73).—Yntema (*J. Amer. Chem. Soc.*, 1932, **34**, 3775) claimed that molybdenum can be deposited from an aqueous bath, but P. and B. were unable to obtain bright deposits by the method he outlined. Steel-grey deposits of molybdenum may be obtained from a solution prepared by the electrolytic reduction of molybdic acid anhydride dissolved in sulphuric acid (sp. gr. 1·450) using platinum electrodes, the ratio of molybdic to sulphuric acid being 2 grm. to 5 c.c., and reducing until 4 amp.-hr. of current per grm. has passed through the solution. The best conditions for plating are a current density of 36 amp./dm.^{2} and a temperature of 50°–55° C. The use of a stirrer does not aid the preparation of the solution or in obtaining deposits. No addition agent was found that would aid in obtaining bright deposits or in the formation of the plating baths.

—S. G.

†**Some Properties of Nickel Electrodeposits.** Robert J. McKay (*Metals and Alloys*, 1936, **7**, (8), 193–198; and (abbreviated) *Metal Cleaning and Finishing*, 1936, **8**, (8), 461–464, 468).—The effects of p_{H}, current density, temperature, cleanliness, and composition on the operation of nickel-plating solutions are briefly discussed and the properties of the product briefly summarized from a review of recent literature (13 references).—A. R. P.

The Ballay Process of Nickel Plating Aluminium and Aluminium Alloys. —— (*Z. Metall- u. Schmuckwaren-Fabrikation sowie Verchromung*, 1936, **17**, (5), 14; *Light Metals Research*, 1936, **5**, (1), 12).—The Ballay process consists in producing on the aluminium articles to be plated thin iron deposits to which nickel adheres very well. The articles are cleaned and degreased and are then immersed for about 30 seconds in a boiling solution of the composition : water 10 litres, hydrochloric acid 0·1 litre, saturated ferric chloride 0·3 litre (45° Bé.). After treatment in this bath the articles are rinsed with a large volume of water and are then ready for nickel plating.—L. A. O.

Alkaline Plating Baths Containing Ethanolamines. II.—A Study of Baths Containing Triethanolamine for the Direct Nickel Plating of Zinc. C. J. Brockman and J. P. Nowlen (*Trans. Electrochem. Soc.*, 1936, **69**, 541–549; discussion, 556).—See *Met. Abs.*, this vol., p. 124.—S. G.

Nickel–Cobalt Alloy Plating from Acid Sulphate Solution. C. B. F. Young and N. A. Gould (*Trans. Electrochem. Soc.*, 1936, **69**, 585–594; discussion, 594–597).—See *Met. Abs.*, this vol., p. 209.—S. G.

Alkaline Plating Baths Containing Ethanolamines. IV.—The Deposition of Nickel–Cobalt Alloys from Solutions Containing Triethanolamine. C. J. Brockman and J. P. Nowlen (*Trans. Electrochem. Soc.*, 1936, **69**, 553–555; discussion, 556).—See *Met. Abs.*, this vol., p. 210.—S. G.

The Simultaneous Electrodeposition of Thallium and Zinc. W. George Parks and I. Milton Le Baron (*Trans. Electrochem. Soc.*, 1936, **69**, 599–610).—See *Met. Abs.*, this vol., p. 163.—S. G.

Zinc Plating. C. M. Hoff (*Met. Ind.* (*N.Y.*), 1936, **34**, (3), 99–100; and *Aluminium and Non-Ferrous Rev.*, 1936, **1**, (8), 383–384).—Read before the Master Electroplaters' Institute of the Mid-West. See *Met. Abs.*, this vol., p. 44.—J. C. C.

Electroplating of Aluminium and Its Alloys with Zinc, Cadmium, Copper, Nickel, and Chromium. V. I. Lainer and S. I. Orlova (*Light Metals Rev.*, 1936, **2**, (18), 308–314; and *Aluminium and Non-Ferrous Rev.*, 1936, **1**, (8), 381–383).—From *Legkie Metally* (*Light Metals*), 1936, (2), 22–33.
—J. C. C.

Effect of the Electrolyte Resistance on the Shape of the Electric Lines of Force. A. Glazunov and A. Kukla (*15me. Congr. chim. indust.* (*Bruxelles, 1935*), **1936**, 1023–1028; *C. Abs.*, 1936, **30**, 5507).—Copper sulphate solutions of different concentrations were electrolyzed, using a copper plate as anode, and a 3 mm.-diam. silver wire placed perpendicular to the surface of the anode as cathode. During electrolysis the current density at different points on the surface of the cathode varied according to their distance from the anode. The thickness of the layer of copper deposited was proportional to the current density, being thinnest at the points farthest away from the anode. With increase in the resistance of the electrolyte, the difference in thickness of the copper coating as a function of the distance from the anode also increases. The thickness of the copper coating was determined by Glazunov's method (anodic solution) at each cm. of length of the cathode.—S. G.

†**The Rôle of Films in the Electrodeposition of Metals.—I–II.** R. Meyer (*Metals and Alloys*, 1936, **7**, (5), 123–126; (6), 155–159).—A correlated abstract with a *bibliography* of 153 references covering the following aspects of the subject : preferential solution films, deposited films, passive films, polishing films, structure of thin films on various substrates, relation between structure

of the basis metal and that of electrodeposits on it, films on electroplated and unplated metals.—A. R. P.

Control of the Cathodic Film in Metallic Deposition. C. G. Fink (*Chim. et Ind.*, 1936, **35**, (5), 1028–1033).—Investigations into the effects on the nature of the cathodic film of the following are summarized : speed of revolving cathode, current density, p_H values, and cathodic distance. It is recommended that for adherent, compact deposits the cathode should revolve at high speed.

—W. A. C. N.

Bright Deposits. H. Krause (*Illust. Zeit. Blechindustrie*, 1936, **65**, (31), 921–922).—The embrittlement of metallic deposits, often associated with the use of colloidal " buffers," may be obviated by the substitution of solutions of metallic salts and other materials. Suitable additions of this type are recommended for producing bright deposits of copper (cyanide or acid bath), brass, zinc, tin (acid bath), and nickel.—P. M. C. R.

The Use of Inhibitors (with Special Reference to Antimony) in the Selective Removal of Metallic Coatings and Rust. S. G. Clarke (*Trans. Electrochem. Soc.*, 1936, **69**, 131–142 ; discussion, 142–144).—See *Met. Abs.*, this vol., p. 164.

—S. G.

Trends in the Plating Industries. C. L. Mantell (*Metal Cleaning and Finishing*, 1936, **8**, (8), 469–471).—A brief review of recent progress in the plating of zinc, cadmium, nickel, and cobalt, and in the anodizing of aluminium.

—A. R. P.

VII.—ELECTROMETALLURGY AND ELECTROCHEMISTRY
(Other than Electrodeposition.)

The Engineering Development of Electrochemistry and Electrometallurgy. Paul Bunet (*Elect. Eng.*, 1935, **54**, (12), 1320–1331).—S. G.

*The Potential of the Antimony Electrode. Henry Vogels (*15me. Congr. chim. indust. (Bruxelles, 1935)*, 1936, 1068–1073 ; *C. Abs.*, 1936, **30**, 5486).— V. puts forward a hypothesis, confirmed by numerous experiments, tending to assimilate the function $e_{Sb} = f(p_H)$ to a system of 3 straight lines obeying the standard equations and standardized by $de/dp_H = 0.058$ v. at 20° C. The ordinates of these straight lines differ from one another by 0·40 v. at the origin and can be assigned to 3 successive states of oxidation of antimony in solution. The state of minimum oxidation must be represented by the ion SbO^-, as shown by measurements of decomposition tension. This hypothesis can be applied also to explain Wulff's recent experiments.—S. G.

*Drop of Potential in the Metallic Electrodes of Certain Electrolytic Cells. Chester Snow (*J. Res. Nat. Bur. Stand.*, 1936, **17**, (1), 101–124 ; and *Research Paper* No. **905**).—In certain precise measurements of electrolytic resistance of solutions, the platinum electrodes are necessarily very thin so that the drop in potential in them cannot be neglected. Formulæ are obtained for this drop in the case of two types of cylindrical shells : one in which the current is axial, and the other partly axial and partly radial. The potential admits of accurate evaluation in the first case, and the results obtained confirm the method outlined for the treatment of a general shape of cell.—S. G.

*Observations on the Rare Earths. XLII.—Studies in the Electrolytic Reduction of Ytterbium. D. W. Pearce and C. R. Naeser, with B. S. Hopkins (*Trans. Electrochem. Soc.*, 1936, **69**, 557–564 ; discussion, 564–565).—The strong reducing influence which surrounds the cathode during an ordinary electrolysis of an aqueous solution was used to reduce ytterbium from its usual trivalent condition to the corresponding bivalent salt. In the reduced condition ytterbium resembled barium and was precipitated as the sulphate.

The precipitated $YbSO_4$ was obtained in a stable, crystalline form which was shown to be almost free from other rare earths. The precipitation was not complete, about 10% of the ytterbium being left in solution presumably in an equilibrium between Yb^{+++} and Yb^{++}. No conditions were found which were effective in removing all of the ytterbium in one process from the neighbouring elements thulium and lutecium.—S. G.

*The Effect of Certain Impurities in the Forming Acid on Plate Forming Time [in the Manufacture of Accumulators]. J. E. Hatfield and H. R. Harner (*Trans. Electrochem. Soc.*, 1936, **69**, 243–251; discussion, 251–253).—See *Met. Abs.*, this volume, p. 164.—S. G.

VIII.—REFINING

The Rhokana Copper Refinery. Archer E. Wheeler and Henry Y. Eagle (*Met. Ind. (Lond.)*, 1936, **48**, (18), 505–510).—See *Met. Abs.*, this vol., p. 210.
—J. E. N.

IX.—ANALYSIS

Quantitative Spectral Analysis. Raymond Breckpot (*15me. Congr. chim. indust. (Bruxelles, 1935)*, **1936**, 988–1002; *C. Abs.*, 1936, **30**, 5523).—A general discussion and review of the possibilities at the present time of the application of quantitative spectral analysis to problems of particular interest to the metallurgical industry, together with examples of the analysis of finished products, metals, ores, and intermediate products, and an explanation of the function of the spectrographic laboratory in the regular control of manufacture.—S. G.

Quantitative Spectrographic Analysis with the Logarithmic Sector. O. Fagioli (*Nuovo cimento*, 1936, **13**, (3), 111–130; *C. Abs.*, 1936, **30**, 5523).— A discussion of the advantages and disadvantages of the logarithmic sector as used in measuring the intensity of lines in the spectrographic analysis of alloys. The means of excitation used with the sector influences the result. It is proposed that the type of excitation be characterized by simultaneous values of effective and maximum current in the spark.—S. G.

Spectrum Analysis. F. Twyman (*Nature*, 1935, **136**, (3441), 609).—T. suggests the use of the term " spectrochemical analysis " to denote the analysis of materials by their spectra, and that " spectrum analysis " be used for the analysis of the structure of a spectrum.—S. G.

*A Simple Method for Differentiating the Alloys of Aluminium. —— (*Rev. Fonderie moderne*, 1936, (Jan. 2), 28–31.—Extract from *Rev. Aluminium*, 1935, **12**, 3009–3013; see *Met. Abs.*, 1935, **2**, 610, 707.—J. E. N.

*A New Specific Reaction for Bismuth by the Formation of Bismuthous Oxide. N. A. Tananaeff (*Z. anal. Chem.*, 1936, **105**, (11/12), 419–422).— Addition of the feebly acid Bi solution to a concentrated solution of $K_4Mn(CN)_6$ produces a black precipitate of BiO. The test is very sensitive and is not given by any other metal.—A. R. P.

*The Quantitative Separation of Aluminium and Beryllium. J. Dewar and P. A. Gardiner (*Analyst*, 1936, **61**, (725), 536–538).—The neutral chloride solution (50 c.c.) of the metals is treated with $6N$-NaOH until the precipitate of hydroxides just redissolves, diluted with hot water to 400 c.c., and well stirred at $100°$ C. for 40 minutes to complete the precipitation of $Be(OH)_2$. If a preliminary test shows that the Al present is more than the Be a known

amount of Be is added to the test to make the Be at least equal to the Al; under these conditions accurate results are obtained in one operation.

—A. R. P.

†On the Problem of the Separation of Bismuth from Lead and Copper. E. A. Ostroumov (*Z. anal. Chem.*, 1936, **106**, (1/2), 36–45).—See *Met. Abs.*, this vol., p. 165.—A. R. P.

*Determination of Arsenic and Antimony in Hard Lead. J. Willemme (*15me. Congr. chim. indust. (Bruxelles, 1935)*, 1936, 166–171; *C. Abs.*, 1936, **30**, 5525).—The standard methods are briefly reviewed, with indications of their disadvantages. A new method is presented and described in detail. It consists essentially in reducing arsenic and antimonic compounds to the arsenious and antimonious states by means of Sn in conc. H_2SO_4 and titrating As + Sb by means of standard $KBrO_3$; reducing a second portion of the sample by means of MeOH followed by Na_2SO_3, boiling off the methyl arsenious ester, titrating Sb with $KBrO_3$, and obtaining As by difference. The method is considered to possess satisfactory accuracy and to be rapid and relatively inexpensive.—S. G.

Determination of Trivalent Chromium in Chromium Plating Baths.—II. Philena Young (*Metal Cleaning and Finishing*, 1936, **8**, (8), 473–476).—Cf. *Met. Abs.*, this vol., p. 369. Full details of the method previously recommended are given.—A. R. P.

*The Rapid Photometric Determination of Copper in Brass and Related Alloys. Kurt Dietrich and Karl Schmitt (*Z. anal. Chem.*, 1936, **106**, (1/2), 23–27, 80).—The alloy (1 grm.) is dissolved in 15 c.c. of 1 : 1 HNO_3, the solution is diluted to 1 litre and 50 c.c. are treated with 10 c.c. of 10% NH_4OH diluted to 100 c.c. and transferred to the photometer. The extinction coefficient is then determined with an appropriate light filter and the corresponding Cu content read from a predetermined curve prepared from standard Cu solutions.

—A. R. P.

*[Testing the] Zinc Coating on Galvanized Iron. J. A. D. Nash (*Analyst*, 1936, **61**, (725), 540–541).—Comparative tests were made with the following methods : (*a*) HCl–$SbCl_3$, (*b*) basic $(CH_3·CO_2)_2Pb$, (*c*) H_2SO_4–$KMnO_4$. The average results obtained over a large sheet of galvanized Fe are approximately the same for all methods. Method (*a*) is the quickest, but (*c*) is probably the most accurate and the most economical in chemicals. Method (*c*) is carried out as follows : a weighed sample is immersed in 10% H_2SO_4 in contact with a piece of Pt foil; when the violent action ceases, the Fe is removed, washed, dried and weighed, and the Fe in the solution determined by titration with $0·1N$-$KMnO_4$, the difference between the original weight and the sum of the two Fe weights is taken as Zn. Commercial coatings vary considerably over the standard sheet.—A. R. P.

X.—LABORATORY APPARATUS, INSTRUMENTS, &c.

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

The Radio-Metallographic Laboratory of the Issy-les-Moulineaux Testing Station of the (French) Air Ministry. F. Fournier (*Bull. Soc. Franç. Élect.*, 1936, [v], **6**, (68), 805–825).—An illustrated description of the equipment and work of a modern laboratory designed for X-ray and spectrographic examination of metals.—P. M. C. R.

Metals and Minerals Polishing Machine. —— (*Instruments*, 1936, **9**, (8), 216).—A six-holder polishing machine is illustrated and briefly described.

—J. C. C.

*A Laboratory Vacuum Casting Furnace. Jack H. Scaff and Earle E. Schumacher (*Metals and Alloys*, 1936, **7**, (8), 204–206).—An induction type of furnace for melting copper, nickel, iron, and their alloys in vacuum (0·01–0·08 mm. pressure) is described with reference to a detailed diagram. The furnace is mounted on a tilting table with an Albarene stone base to act as insulator for the electrical connections. Inside the copper induction coil is a silica tube open only at the upper end which is connected with a suitable cement and clamps to a steel head carrying a horizontal steel side tube containing the mould. The silica tube contains a silica or other refractory crucible mounted in a protective alundum tube supported on a heat insulating material. The top of the silica tube and the steel head are water-cooled and the joint is protected inside from radiant heat by a nickel reflector. All joints are fitted with matched flanges and lead gaskets, concentric rings being forced into the lead to ensure air-tightness by means of the screws which hold the flanges in place. The vacuum outfit consists of a 4-stage Gaede mercury pump backed by a 2-stage oil pump and provided with a liquid air trap in the flexible corrugated copper pipe-line joining it to the furnace.—A. R. P.

A New Dilatometer for the Thermal Analysis of Metals. A. Metz (*Giesserei*, 1936, **23**, (18), 437–439).—The new Leitz universal dilatometer is illustrated and its operation described with reference to electrical and optical diagrams. The instrument registers curves automatically and the specimens (rods up to 50 mm. long and 5 mm. in diam.) can be heated *in vacuo* or in any desired gas.—A. R. P.

Determination of Friction Coefficients Should be Standardized. A. W. Burwell and J. A. Camelford (*Nat. Petrol. News*, 1936, **28**, (33), 38–39).—An illustrated description is given of an apparatus for the determination of coeffs. of kinetic friction. It is claimed that bearing temperatures can be controlled over a wide range, alteration of bearing pressure can be effected without shock, oil supply is easily controlled, and the apparatus is sufficiently delicate to measure friction drag. The moving surface is of steel; any type of bearing metal may be used. Alternatively the properties of different lubricants can be compared with respect to a given type of bearing. A bronze containing 2% of lead is used in standardizations of this type.—P. M. C. R.

An Apparatus for Determining the Area of Cross-Section of Zinc Single Crystals. Aluin W. Hanson (*Rev. Sci. Instruments*, 1936, [N.S.], **7**, (2), 109).—S. G.

*A Machine for Drawing Pole-Figures Directly from X-Ray Diffraction Patterns. Dan McLachlan, Jr. (*Rev. Sci. Instruments*, 1936, [N.S.], **7**, (8), 301–304).—A full description of the machine. See *Met. Abs.*, this vol., p. 370.—S. G.

Practical Apparatus for Spectroscopic Chemical Analysis. John L. Gring and George L. Clark (*Rev. Sci. Instruments*, 1936, [N.S.], **7**, (8), 305–306).
—S. G.

A Rotating Sector for Quantitative Analytical Spectrography. M. F. Hasler and R. W. Lindhurst (*Rev. Sci. Instruments*, 1936, [N.S.], **7**, (3), 137–139).—A new sector arrangement is devised for use with a grating spectrograph in quantitative spectrography, which obviates certain difficulties encountered with the logarithmic sector.—S. G.

New Spectral Photometer for Quantitative Spectral Analysis. H. Moritz (*Germanskaja Tehnika* (*Z. deut. Technik*), 1936, **15**, (5), 96–98).—[In Russian.] Description of a Zeiss spectral photometer.—N. A.

XI.—PHYSICAL AND MECHANICAL TESTING, INSPECTION AND RADIOLOGY

*A Method of Magnetic Testing for Sheet Material. S. L. Burgwin (*Rev. Sci. Instruments*, 1936, [N.S.], **7**, (7), 272–277).—A method for building up a magnetic circuit from strips of sheet material has been found which permits testing for magnetic properties either by d.c. or a.c. methods, just as in the case of the ring sample but without the inconvenience of the ring sample in that a permanently wound test frame similar to that of the Epstein test may be used. In testing this magnetic circuit, an approximate method may be used where simplicity of testing and consistency of results are required rather than absolute accuracy. For tests where absolute accuracy is more important than simplicity of testing, a comparative test has been developed. Satisfactory results may be obtained by these methods on materials with permeabilities as high as 100,000.—S. G.

*On a Technical Determination of the Modulus of Elasticity of Metals at High Temperatures by Means of the Creep Limit Apparatus of Dr. W. Rohn. Helmut Krainer (*Messtechnik*, 1936, **12**, (6), 111–114).—The specimen under load in the Rohn creep test at high temperature decreases slightly in length when the load is removed; this decrease may be compensated by increasing the temperature, and the number of ° C. necessary to effect this forms the basis of the calculation of the elastic modulus at the temperature of the test. A mathematical expression is deduced for determining the true creep limit by making allowance for the change in elastic modulus with rise in temperature.
—A. R. P.

Fatigue Strength. H. Dinner and H. Christen (*Schweiz. tech. Zeit.*, 1936, (2), 77–81).—A general discussion of the principles underlying the determination of fatigue strength and its significance in construction work.—W. A. C. N.

Fatigue Stress and Its Diminution. H. Oschatz (*Mech. World*, 1936, **99**, (2563), 161–168).—Abstract of a paper presented to the Engineers' German Circle, entitled " Fatigue Strength and Its Determination."—F. J.

*Determination of the Brinell Number of Metals. Serge N. Petrenko, Walter Ramberg, and Bruce Wilson (*J. Res. Nat. Bur. Stand.*, 1936, **17**, (1), 59–95; and *Research Paper* No. 903).—The procedure used in making Brinell tests must be closely controlled in order that two observers testing a given metal at different places shall obtain Brinell numbers that are in close agreement. Small variations in testing procedure are inevitable so that it is important to know the effect of these variations on the magnitude of the Brinell number obtained. The authors consider the effect on the Brinell number of such variations with the help of the data available in the literature supplemented by new tests wherever the existing data seemed deficient. Attention is given to the effect on the Brinell number of variations in testing procedure, *i.e.* rate of applying the load, time under nominal load, error in load, and error in measuring the diameter of the indentation. The effect of variables residing in the specimen is discussed under the headings of non-uniform properties, curvature of surface, thickness, spacing of indentations, and angle between load line and normal to the specimen. Variations in the type of ball used were considered, particular attention being devoted to differences in elastic deformation, and in permanent compression of the ball under load. The paper concludes with recommendations for a test procedure which would lead to greater concordance in the Brinell numbers obtained by different observers using a ball of a given diameter on a specimen of given metal.—S. G.

The Measurement of Hardness. S. R. Williams (*Instruments*, 1936, 9, (8 221–223).—In a penetration hardness test, the resistance to penetratic depends on the angle of the penetrator and the frictional resistance between and the test-piece (both properties of the testing instrument) as well as on t cohesion and the internal friction of the material. It is suggested that mo fundamental knowledge of hardness might be derived from studies of resistivit its change with varying magnetic fields, and similar properties which deper on the internal forces holding the material together. Some tests on carb steels are briefly described.—J. C. C.

A Direct-Reading Hardness Testing Machine. —— (*Engineer*, 1936, 16 (4198), 687).—An illustrated description of a machine which is designed give direct readings for routine hardness tests of materials ranging from 0· to 0·6 mm. in thickness. 60–200 Brinell degrees of hardness are given l the penetration of two opposed points between which the test-piece is grippe The indicator records the sum of the depths of the two penetrations ar measures the mean hardness of the opposite faces of the test-piece.—R. Gr.

Hardness Tester. —— (*Instruments*, 1936, 9, (8), 213).—The " Diam Brinell " hardness testing machine is briefly described. [*Note by abstracto* This appears to resemble closely the Vickers diamond pyramid tester.]

—J. C. C.

RADIOLOGY.

†**The Application of X-Rays to Metallurgy.—II.** C. Hubert Plant (*Met lurgia*, 1936, 14, (82), 101–103).—The practical working of X-ray apparati and the results which can be obtained without a knowledge of the high branches of physics, or without having to understand intricate analytic mathematics are considered, and the fundamental principles involved in t application of X-rays to the study of crystals and in the determination of t crystal structure are discussed. Two different types of crystal lattice—t face-centred cubic and the body-centred cubic—are dealt with, and a meth of drawing a unit cell from the body-centred cube is described. On t practical side of the subject, the Laue method of crystal analysis is considered brief detail.—J. W. D.

Radiography of Metal. Kent R. Van Horn (*Metal Progress*, 1936, 30, (45–51).—A summary of current methods of X-ray examination of metals.

—P. M. C. R.

Modern Distinguishing Signs in Radiography. F. Wulff (*Elektroschwei ung*, 1936, 7, (5), 89–92).—Various methods for marking the objects to radiographed, in order to recognize the exact location of each exposure, a described, with particular reference to weld-seams. A new method is presente which is claimed to be free from all the disadvantages of the others, and whi permits exact comparison of picture and seam even after the lapse of co siderable time. The application of this method to the case of a weld locomotive firebox is explained in detail.—H. W. G. H.

*Non-Destructive Testing of Steel Weld Seams by Means of Gamma Radiatic M. Widemann (*Autogene Metallbearbeitung*, 1936, 29, (13), 196–199).—Rad tion from mesothorium was used to examine a series of welds, and the limiti dimensions of defect (incomplete junction, crack, slag inclusion, blow-hole, surface cavity) which could be detected, were determined. The results she that the method is very much less sensitive than X-ray examination.

—H. W. G. H.

XII.—TEMPERATURE MEASUREMENT AND CONTROL

(Continued from p. 373.)

Measurements with a New Colour Pyrometer. K. Guthmann (*Stahl u. Eisen*, 1936, 56, (17), 481–489).—A description of the features and uses of the Bioptix pyrometer. The greatest differences in temperature measurement by means of the latter and by a standard radiation instrument, occurred when dealing with flame and metal melting temperatures. The accuracy of the new instrument is said to be $\pm$ 10° C.—W. A. C. N.

*Comparison of Platinum Resistance Thermometers with the Helium Thermometer from $-$ 190° C. to $-$ 258° C. W. H. Keesom and A. Bijl (*Physica*, 1936, 3, (6), 418–424; also *Comm. K. Onnes Lab. Leiden*, No. 242b; and (summary) *Proc. K. Akad. Wet. Amsterdam*, 1936, 39, (5), 574–575).—[In English.] The resistance curves of 4 platinum resistance thermometers were determined between $-$ 190° and $-$ 258° C. The curves show considerable differences. The rather complicated resistance curve of platinum at lower temperatures makes it doubtful whether this metal is suitable as a standard metal for resistance thermometry below $-$ 190° C.; gold may be more suitable in this range. Henning and Otto's formula is applicable to 3 of the thermometers.—S. G.

XIII.—FOUNDRY PRACTICE AND APPLIANCES

(Continued from pp. 374–375.)

The Castability of Metals and Alloys. Wilhelm Patterson (*Giesserei*, 1936, 23, (17), 405–410).—A summary and review of recent work.—A. R. P.

*On the Artificial Production of Metal Nuclei in Metal Melts During Solidification. Erich Scheil (*Z. Metallkunde*, 1936, 28, (8), 228–229).—The grain-size of cast ingots can be refined appreciably by inserting wires of the metal in the mould before casting. The resulting grain-size is a function of the number and diameter of the wires used, and for every metal there are critical values of these which give the best grain-size. The effects are illustrated by experiments on a 3% silicon–steel and on pure aluminium.—A. R. P.

Casting and Moulding [in the Aluminium Foundry]. Oskar Summa (*Aluminium*, 1936, 18, (4), 135–138).—The precautions to be taken in designing complicated shapes to be cast in aluminium are critically discussed with reference to several examples.—A. R. P.

The Casting of Elektron and Hydronalium Alloys. P. Spitaler (*Aluminium*, 1936, 18, (19), 429–432; and *Light Metals Rev.*, 1936, 2, (22), 391–392).—Summaries from *Giesserei*, 1936, 23, (8), 177; see *Met. Abs.*, this vol., p. 171.
—L. A. O.

Copper–Tin Alloys in Power Transmission. Centrifugal Casting of Bronze Gears. R. C. Stockton (*Met. Ind. (Lond.)*, 1936, 49, (5), 103–105).—A concise description of the process, moulds, and cores. The suitability of alloys is discussed.—J. E. N.

†The Casting of Nickel Silvers. M. Ballay and R. Chavy (*Met. Ind. (Lond.)*, 1936, 48, (12), 347–351; (13), 375–378, 389; also *Rev. Nickel*, 1936, 7, (1), 2–14; and *Cuivre et Bronze*, 1936, 9, (72), 3–21).—Read before the Congrès International des Mines, de la Métallurgie, et de la Géologie appliquée (this paper is not being printed in the official report of the Congress). The principal properties of and specifications for nickel brasses are summarized, and the defects commonly met with in castings of these alloys are described. Laboratory and foundry tests were carried out to determine the best conditions for obtaining sound castings. In the former, the fuel was town gas, and heavy oil furnaces or coke crucible furnaces were used in the latter. When the alloy contains small quantities of gas, high temperature (1300°–1350° C.) melting and superheating are recommended. Gas absorption is very different in the

three types of firing. The addition of a reducing metal, as manganese or aluminium, before casting gives freedom from blow-holes. A large number of practical recommendations are given as to the make-up of the charge, use of fluxes, charging, melting, casting, gas elimination, moulding sand, and moulding. 21 references are given.—J. H. W.

Production and Use of Lead Bearing Metals. R. Schmidt (*Stahl u. Eisen*, 1936, **56**, (8), 228–231).—The properties of suitable lead bearing metals are described, and the processes for the hardening of lead by the addition of sulphur, alkalis, or alkaline earth metals are explained. The manufacture, properties, and applications of " Union " bearing metal having the composition—lead 98, magnesium 1·5, and calcium 0·2% are given.—W. A. C. N.

Recommended Practices for Sand-Cast Magnesium Alloys. Report of Non-Ferrous Division Committee [of A.F.A.] on Recommended Practices. —— (*Trans. Amer. Found. Assoc.*, 1936, **44**, 33–50; and (abridged) *Found. Trade J.*, 1936, **55**, (1047), 197–199, 202).—See also *Met. Abs.*, this vol., p. 319. This, the second of a series of recommended practices, drawn up by those considered to be specialists, is a comprehensive review of magnesium alloy foundry practice. The preparation of the special moulding sand and facings, cores, gates, and risers are concisely described. Special attention must be paid to the fluxing, melting, and alloying, and the melting pot and casting ladle are illustrated. Further sections deal with finishing processes for castings, heat-treatment, defects, their cause and prevention, properties and applications, and the last section gives the trade names of the principal American products.—J. E. N.

Production of Nickel–Chromium Alloys for Electrical Heating Elements. W. F. Randall (*Wild-Barfield Heat-Treat. J.*, 1936, **1**, (8), 98–102).—Purity of the constituent metals is essential, and the refractories used should be well seasoned. A viscous slag for the exclusion of air during melting is suggested. Evacuated furnaces have been tried. The metal should not be superheated. Moulds should be preheated to 500°–600° C. An unbroken stream and the prevention of slag carry-over are essential. The ingot surfaces will usually have to be milled or scalped to remove imperfections, and this is best done after the initial hot-working. Hot-working is normally carried out at 1300° C.
—W. A. C. N.

General-Purpose Babbitt Metalling Mould. —— (*Mech. World*, 1936, **100**, (2586), 82).—A jig suitable for dealing with the smaller types of half-bearings is illustrated and described.—F. J.

***Deformation and Resilience of Moulding Sand.** H. W. Dietert and R. A. Dietert (*Trans. Amer. Found. Assoc.*, 1936, **44**, 139–156; discussion, 157).— The deformation and resilience are two properties of moulding sands which have received little attention. They have been studied by stress–strain diagrams on A.F.A. standard test-pieces, in which one variable of the sand has been modified at one time. The importance of the two properties in relation to the moulding, and handling properties of moulds are discussed. The deformation is the strain measured on the standard compression test, and the resilience is derived from the work done in breaking the specimen, and combines the deformation and compression strength. As a result of their investigation the authors find that deformation increases as moisture increases, as the sand becomes finer, as the clay content is high or low, as the mould hardness increases, and as the sea-coal increases. They also found that sand resilience is increased by increasing moisture content, fine material, clay content, mould hardness, and sea-coal content. The significance of these properties was emphasized in the discussion, and it was pointed out that resilience was probably the property which previously had been apparent only to a moulder by the feel of the sand.—J. E. N.

Mechanical Sand Handling for Low-Tonnage Foundries. E. W. Beach (*Trans. Amer. Found. Assoc.*, 1935, **43**, 415–422; discussion, 422–426).—S. G.

*Surface and Venting Property of Moulding Sands. J. Verö (*Bányamérnöki és Erdömérnöki Föiskola bányászati és kohászati osztalyának Köszlémyciböl (Mitt. berg. hütt. Abt. Kg. ung. Hochschule für Berg- u. Forstwesen zu Sopron)*, 1934, **6**, 99–119 ; *C. Abs.*, 1936, **30**, 5539).—Tests were carried out with Steinitzer's apparatus to investigate the effect of grain-size on the venting property of moulding sands ; only quartz sand free of clay and dust was used. A linear relationship exists between the factors expressing the venting property, namely the time occupied by the passage of a gas, and the difference of pressure effected by the passage of a gas. Another linear relation exists between the square root of the resistance and the reciprocal dimensions of the grains, but only for grains of equal size and sands free of mixtures ; the latter have always a greater resistance than pure quartz sand. The surface factor, *i.e.* the whole surface of grains contained in a unit volume or weight, is of deciding influence.
—S. G.

Fifteen Years of Foundry Apprenticeship at the Falk Corporation. V. J. Hydar (*Trans. Amer. Found. Assoc.*, 1935, **43**, 321–327).—S. G.

Some Suggestions for Starting and Carrying on a Foundry Apprenticeship System. J. E. Goss (*Trans. Amer. Found. Assoc.*, 1935, **43**, 328–342).—S. G.

Foundry Apprenticeship : Discussion. —— (*Trans. Amer. Found. Assoc.*, 1935, **43**, 343–350).—Discussion of papers by V. J. Hydar and J. E. Goss (preceding abstracts).—S. G.

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

(Continued from p. 375.)

On the Problem of the Working-Up of Aluminium Scrap. W. Guertler (*Aluminium*, 1936, **18**, (6), 256–261).—Methods of sorting the scrap and furnaces for melting it are described, and practical hints are given for obtaining good yields of recovered metal.—A. R. P.

XV.—FURNACES AND FUELS

(Continued from pp. 375–376.)

Gas Firing of Metallurgical Furnaces. —— (*Metallurgia*, 1936, **14**, (82), 107).—The subject of high-pressure and low-pressure gas-firing of metallurgical furnaces is discussed from the view-points of accurate control, stability of flame, uniformity of heating, use of hot and dirty gas, and use of preheated air, and the advantages of low-pressure firing are stressed. The basic principle of the design of burner used for such firing is the passage of air and gas in alternate thin layers, one or both of which are given a whirling motion by means of spiral guides and passages.—J. W. D.

Gas in Industry and Commerce. Dean Chandler (London : **1936**, 47 pp. ; and (summary) *Met. Ind. (Lond.)*, 1936, **48**, (10), 295–299).—Address delivered at a Joint National Gas Conference held at the British Industries Fair. After a brief discussion of the present position and future prospects of the gas industry, numerous applications of coal-gas are illustrated and described, including air heating, vitreous enamelling, non-ferrous metal melting, heat-treatment of metals, and soldering. The questions of atmosphere and temperature control for metallurgical applications are dealt with, and, in both, the use of gas is shown to have advantages over other fuels.—H. W. G. H.

Practical Applications of Controlled Atmosphere Furnaces. T. B. Bechtel (*Indust. Heating*, 1936, **3**, (4), 221–228).—An illustrated article dealing with

furnaces in which the atmosphere consists of the products of partial combustion of suitable gases. The analysis is usually within the following ranges : hydrogen 2–18, carbon monoxide 3–11%. Most benefit is said to be obtained from the use of a controlled atmosphere when heating and cooling are carried on within the furnace or in near-by auxiliary equipment. The applications of the method in brazing and annealing are discussed. The conditions to be met in erecting the necessary plant are reviewed.—W. A. C. N.

The Deblanchal Rotary Melting Furnace. C. F. Herington (*Heat-Treat. and Forging*, 1936, **22**, (2), 93).—See *Met. Abs.*, this vol., p. 129.—J. E. N.

Heating Furnaces for Hot-Pressing Aluminium Parts. K. Robertz (*Aluminium*, 1936, **18**, (7), 291–297).—Various types of electric furnaces with automatic temperature regulators are described.—A. R. P.

Electrically Heated Industrial Furnaces. R. Boye (*Eng. Progress*, 1935, **16**, (11), 265–272).—A review.—S. G.

Improved Tungsten-Wound Furnaces for High Temperatures. H. Cieciorra and W. Dawihl (*Keram. Rundschau*, 1936, **44**, 171–172 ; *C. Abs.*, 1936, **30**, 4406).—A tungsten-wound furnace is illustrated and described. By increasing the number of turns near the ends more constant temperature is maintained. Hydrogen or hydrogen + carbon monoxide is passed through the refractory body. When an impervious alumina tube is used, a temperature of 1800° C. may be maintained with an oxidizing atmosphere within the tube.
—S. G.

Electric Furnaces with Carbon Radiator. Henri George (*Elect. Eng.*, 1935, **54**, (11), 1195–1199).—See *Met. Abs.*, 1935, **2**, 254.—S. G.

Coreless Induction Furnaces. —— (*Mech. World*, 1936, **99**, (2574), 450).— Technical details and advantages of the high-frequency induction furnace are briefly set forth.—F. J.

Frequency Changers for Induction Furnaces. Robert W. Wieseman (*Electrochem. Soc. Preprint*, **1936**, Oct., 81–98).—Synchronous machines can be built with a rotating armature and a stationary field (this type is now seldom used) ; with a rotating field and a stationary armature (conventional type for commercial frequencies) ; with a rotating field structure and a stationary armature, but with the field winding stationary (inductor type) ; and, finally, with a single stationary winding which serves both as an armature and as a field winding (reaction type). From this variety of machine constructions the inductor type is recommended for induction furnace high-frequency power generation because of its reliability and high efficiency. W. describes the construction and performance characteristics of high-frequency inductor generators.—S. G.

XVI.—REFRACTORIES AND FURNACE MATERIALS

(Continued from pp. 376–377.)

A New Refractory. —— Sachot (*Chaleur et Industrie*, 1935, **16**, (181), 265–266).—" Duralite," a French neutral refractory, can either be poured as a cement into moulds, when it sets hard in the cold after a few hours, or used as a plastic cement for hot-patching.—J. C. C.

Some Factors Affecting the Durability of Refractories. J. F. Hyslop (*Metal Treatment*, 1936, **2**, (6), 86–88 ; and (summary) *Found. Trade J.*, 1936, **55**, (1046), 179, 182).—The durability of a refractory depends on its thermal expansion, volume stability, strength under load, and resistance to spalling, corrosion, abrasion, and furnace atmospheres, even more than on its refractoriness. These characteristics, their evaluation, and the properties of some important refractories are briefly discussed.—J. C. C.

XVIII.—WORKING

Working Copper and Copper–Zinc Alloys. William Ashcroft (*Metallurgia*, 1936, **14**, (82), 99–100).—The copper and copper–zinc alloys are discussed from the points of view of hot- and cold-working, the importance of correct annealing is stressed and the need for temperature controlled furnaces is emphasized. The effect of impurities is also dealt with, and the range of copper–zinc alloys available for working is considered in relation to their crystal structure, on which the ease of annealing and working depends. Reference is also made to internal stresses set up by cold-working, and the removal of such stresses by heat-treatment or by altering the composition.—J. W. D.

*Cold-Deformation and Recovery of Alloys with an Ordered Atomic Distribution. (Dahl.) See p. 394.

Spread in Rolling with Different Rolling Speeds and Steel Compositions. A. Spenlé (*Stahl u. Eisen*, 1936, **56**, (19), 544–549).—The results show that changes in composition materially affect the spread.—W. A. C. N.

Spread in Rolling and Its Dependence on Speed of Rolling, Roll Diameter, and the Composition of the Material Rolled. O. Emicke and E. Pachaly (*Stahl u. Eisen*, 1936, **56**, (21), 589–599).—Although dealing principally with the rolling of steel, the principles enunciated are of interest in non-ferrous work. Two equations, involving the different factors, by Geuze and Sedlaczek, respectively, are compared. It is shown that the calibration method of Emicke, based on the Sedlaczek formula, best fits the phenomena of spreading during rolling.—W. A. C. N.

Metallurgical Control in the Production of Non-Ferrous Sheet and Strip. A. F. Dunbar (*Modern Eng.*, 1935, **9**, (9), 346–351 ; (10), 404–407).—See *Met. Abs.*, this vol., p. 56.—H. W. G. H.

The Roll Problem in Backed-Up Mills for Cold-Reduction. Geo. A. V. Russell and S. S. Smith (*Iron Steel Inst. Advance Copy*, **1936**, Sept., 26 pp. ; and (summary) *Met. Ind. (Lond.)*, 1936, **49**, (14), 335–340).—The development of heavy cold-rolling operations on mills of the backed-up type has directed attention to the rolls employed. The paper is a record of experience with both the working and backing rolls in a large installation. The various types of roll used or now available are considered from the points of view of use and manufacture, and characteristic modes of failure are illustrated and examined. The stress relationships occurring are then contrasted with those obtaining in the rolls of mills of the ordinary two-high type. Finally, some suggestions are advanced for improving backed-up roll performance.—S. G.

Prospects of Gold Thread Manufacture in South India. D. M. Amalsad (*Indian Textile J.*, 1935, **45**, (539), 372–375 ; *J. Textile Inst.*, 1935, **26**, A614).— A description is given of the manufacture of gold thread by drawing silver into a flattened wire (lametta), coiling it round silk thread, and gilding it by electrodeposition of gold. A diagram of the gilding machine is given. Reference is made to production costs. Tables are given showing the quantity and value of silver and gold thread imported into India and into the Madras Presidency during the period 1921–1934.—S. G.

Ardoloy-Tipped Drawing Dies. —— (*Met. Ind. (Lond.)*, 1936, **49**, (10), 235).—A brief illustrated description of adjustable drawing dies faced with Ardoloy for drawing wire, rods, and tubes.—J. E. N.

Preparation of Flattened Copper Tubing Coils. Edward P. Barrett and William L. Barrett (*Indust. and Eng. Chem. (Analyt. Edn.)*, 1936, **8**, (4), 311).— Circular tubing is drawn through special dies to produce the flattened tube which is then wound into coils for induction furnaces over a mandrel in a lathe. Silver solder is used for making any necessary joints in the coils.—A. R. P.

F F

The Manufacture of Copper Tubing. O. Z. Klopsch (*Mech. World*, 1936, 99, (2558), 35–36).—Abstract of a paper read before the American Society for Metals. Cf. *Met. Abs.*, this vol., p. 280.—F. J.

Some Causes for the Failure of Lead and Lead Pipes and Suggested Remedies. E. King and K. Gray (*J. Trans. Junior Inst. Eng.*, 1935, 45, 123–138).—The manufacture of lead pipes by extrusion is first described. The various types of failure are then reviewed. (I.—) Mechanical, due to (*a*) variation in wall thickness, (*b*) stress of freezing water, (*c*) fatigue in long pipe runs subjected to variable loads; (II.—) Chemical corrosion by (*a*) cement, (*b*) chemical constituents of soil, (*c*) water and air in combination, (*d*) damp timber; (III.—) Electrolytic corrosion by (*a*) stray currents from electrical systems, (*b*) action of impurities; (IV.—) Inclusions, principally oxides. In each instance remedial or preventive measures are suggested. The stability of ancient lead pipes, notably free from impurities, is discussed.—W. A. C. N.

***The Influence of Inhomogeneity of the Metal in the Flow Process in the Dick Extrusion Press.** Hermann Unckel (*Z. Metallkunde*, 1936, 28, (6), 151–154; and (summary) *Light Metals Research*, 1936, 5, (1), 10–12).—Comparison of the flow-lines exhibited by wax–chalk mixtures and hot aluminium in extrusion from the Dick press shows that the region of principal flow in the metal is much more extensive than in the wax, and a radial component of the velocity of flow is set up just below the piston which leads to instability in the flow of the metal through the die. These difficulties can be overcome by using a piston with a concave lower end, by heating the receiver and by using a die with a conical opening.—A. R. P.

Metallurgical Aspects of Deep-Drawing. IV.—A Forecast of Possible and Desirable Improvements in Deep-Drawing Metal and Practice. J. D. Jevons (*Met. Ind. (Lond.)*, 1936, 49, (1), 6–10; (3), 62–65).—See also *Met. Abs.*, this vol., pp. 175, 218, and 275. It is suggested that improvement in the quality of deep-drawing metal will be achieved by attention to melting practice, ingot size, annealing under ideal conditions, and development in rolling-mill plant. On the part of the user progress may be made in drawing practice by design and pressure application methods, tools, lubricants, warm drawing, and inter-stage annealing. Reference is made to polishing and plating the finished articles and the possible use of plated sheet is mentioned. Progress will be considerably aided by co-operative research and by intelligent application of the results of current fundamental research.—J. E. N.

The Deep-Drawing Capacity of Aluminium. —— (*Metallurgist* (Suppt. to *Engineer*), 1936, 10, 139–141).—A critical summary of a paper by Werner Helling, *Metallwirtschaft*, 1936, 15, (17), 388, 409; see *Met. Abs.*, this vol., p. 322.

†**Drop Stamping Plant and Practice for Non-Ferrous Metals.** John Stewart (*Met. Ind. (Lond.)*, 1936, 49, (11), 251–255).—The two types of stamps in general use are friction drive or steam or air. Practical working details of each type are described. The anvil must be 14–20 times the weight of the tup, and is the important limiting factor in the size of stamps. A table shows the weights of the relative parts, power, stroke, speed, &c., and the production, maintenance, and repair of dies is described.—J. E. N.

XIX.—CLEANING AND FINISHING

(Continued from pp. 377–378.)

†**The Spoilage of Non-Ferrous Components by Acid Treatments.** E. E. Halls (*Metallurgia*, 1936, 14, (82), 91–93).—In the acid-dip treatment of non-ferrous metals and alloys, as a preparatory process to electroplating, bright acid treatments, and various clear lacquer finishes, it is necessary to control the

formulation of acid mixtures, immersion temperatures, and immersion times. Data are given showing the reduction in thickness of 70 : 30 brass sheet in cold nitric acid solutions and in hot and cold nitric/sulphuric acid mixtures for an immersion time of 30 seconds ; and the reduction in dimensions of phosphor–bronze and nickel–brasses in hot and cold nitric acid, and nitro-sulphuric acid pickles for a similar period. Recommendations are made for suitable acid–dips for the removal of heat-treatment oxide, for use prior to nickel-plating, and for bright finishing, with brass, phosphor–bronze, and nickel–brass.

—J. W. D.

Inhibitors in Pickling. P. R. Russell (*J. Amer. Zinc Inst.*, 1936, **17**, 81–85 ; discussion, 85–87).—The functions and desirable properties of inhibitors are discussed in a general way, and some recommendations are given for pickling various types of steel.—H. W. G. H.

XX.—JOINING

(Continued from p. 378.)

*Researches with Reaction Solders for Aluminium. —— Neubauer-Nicolini (*Aluminium*, 1936, **18**, (4), 139–142).—A mixture of zinc chloride 90, ammonium bromide 8, and sodium fluoride 2% has been recommended for use in soldering aluminium, since at high temperatures it reacts with the aluminium forming zinc which then behaves as a solder and aluminium chloride which acts as a flux. N.-N. finds that the reaction commences at 420°–430° C., and a still higher temperature is required to produce a good joint. This overheating results in a loss of tensile strength and a decrease in corrosion-resistance. To overcome these difficulties N.-N. carried out a series of tests in which the ammonium bromide was replaced by ammonium chloride and the zinc chloride wholly or partly by stannous chloride. Although the use of the tin salt reduced the reaction temperature, the joints obtained were not so strong owing to the poorer diffusing power of tin into aluminium. The use of ammonium chloride instead of ammonium bromide is advantageous ; omission of the fluoride constituent makes a less ductile joint, and the use of the double zinc ammonium chloride produces too fluid a slag.—A. R. P.

*Soldered Joints in Aluminium Cables. G. Kramer (*Elektrotech. Z.*, 1930, **57**, (24), 675 ; and *Aluminium*, 1936, **18**, (7), 299–302).—A method of joining stranded cables by means of a so-called " reaction solder " and special flux (nature of neither is stated) is described. The apparatus required is the same as that for soldering copper cables and the resulting joints are claimed to be strong and corrosion-resistant.—A. R. P.

The Soldering of Nickel and Its Non-Ferrous Alloys. A. Boutté (*Rev. Nickel*, 1935, **6**, (3), 127–131).—A general description of the soldering of pure nickel by electrical methods, the autogenous welding of Monel metal and white metal, and the soldering of Inconel.—W. A. C. N.

Fluxes and Solders. E. R. Wagner (*Radio Eng.*, 1936, **16**, (Apr.), 8–9 ; (May), 10–11, 14 ; *C. Abs.*, 1936, **30**, 5547).—Soldering fluxes are classified as water-soluble and water-insoluble ; examples are given of both. The choice of solder is affected by melting point, fluidity at working temperature, rate of solidification, hardness and tensile strength. Common fluxes and lead–tin–antimony solders are listed. Physiological considerations are necessary in soldering work in confined spaces.—S. G.

Progress in Electric Furnace Brazing. H. M. Webber (*Iron Age*, 1936, **138**, (6), 24–27, 50).—Describes the applications of the electric furnace brazing process.—J. H. W.

The Welding of Aluminium. —— (*Soudure et Oxy-Coupage*, 1936, **13**, (73), 294).—Advice is given to welders who have had no experience of aluminium.

The leftward method is recommended, the blowpipe having a capacity of 75–100 litres of acetylene per hr. per mm. thickness of material.—H. W. G. H.

Repairing of Aluminium Castings by Welding Processes. W. Herrmann and Edmund R. Thews (*Welding Ind.*, 1936, **4**, (3), 90–94).—The advantages of welding are pointed out and the principles to be considered are explained. The preparation of the parts to be welded, careful preheating, the use of suitable fluxes, the welding technique, and after-treatment of the finished articles are discussed. Heat-treatment of the welded casting is said to be unnecessary if preheating, welding, and cooling are carried out as recommended.—H. H.

†**Position of Electrical Spot-Welding for Aluminium and Its Alloys.** F. Bollenrath and W. Bungardt (*Aluminium*, 1936, **18**, (4), 125–133).—Present practice in the spot-welding of aluminium and its alloys is critically reviewed. The physical, chemical, and structural properties of the alloys, especially the hardenable alloys, necessitates a specially built machine and a specialized technique. The Sciaky and the Bollenrath machines are so designed as to use the correct pressure and current to produce a weld by pure recrystallization which gives the best structure and properties.—A. R. P.

Methods of Welding Aluminium and Its Alloys. Jacques Douchement (*Metallurgist* (Suppt. to *Engineer*), 1936, **10**, 155–156).—Summary of a paper by D. in *Rev. Mét.*, 1936, **33**, 189; see *Met. Abs.*, this vol., pp. 131, 277.—L. A. O.

*Electrical Conductivity Measurements on Welded Pure Aluminium. (Buser.) See p. 385.

Jointing of Materials by Welding–Applications in the Aircraft Industry. R. H. Dobson and R. F. Taylor (*Welding Ind.*, 1936, **4**, (3), 99–104).—Aluminium and magnesium alloys are briefly touched upon.—H. W. G. H.

Bronze-Welded Monel Metal. O. C. Jones (*J. Amer. Weld. Soc.*, 1936, **15**, (7), 18–19).—Monel metal laundry plant is reconditioned by bronze-welding.

—H. W. G. H.

The Comparative Efficiency of Fuel Gases for Welding and Cutting Steel. George V. Slottman (*Internat. Acet. Assoc. Proc.*, 1934, 40–51; and *Indust. Gases*, 1935, **16**, (1), 41–44).—It is shown by theoretical reasoning that acetylene is more efficient than propane for welding and cutting. Test data on cutting are quoted to confirm this reasoning.—H. W. G. H.

Hydraulic Valves to Resist Back-Fire and Explosion Pressure. Otto Mues (*Autogene Metallbearbeitung*, 1936, **29**, (12), 179–181).—The stringent regulations and tests for safety hydraulic valves in Germany are explained, and two forms of apparatus fulfilling the requirements are described.—H. W. G. H.

Theory of Electric Arc Welding. W. Fink (*Elect. Welding*, 1936, **5**, (29), 150–152; (30), 205–213).—The passage of electrons in the d.c. arc, the ionization of the gap, and the " freezing " of the cathode spot are explained. The arc characteristic is then considered in relation to the generator characteristic with current regulation by alteration of no-load voltage or choke resistance. The a.c. arc is briefly discussed, and, finally, the possibility of overhead welding is explained by the pinch effect theory.—H. W. G. H.

Electric Arc Welding Machines. J. M. Willey (*Welding Ind.*, 1936, **4**, (5), 202–212).—Read before N.-E. Branch of Institute of Welding. The paper is divided into three sections : in the first, the static and dynamic characteristics of d.c. welding generators are examined, the significance of open-circuit voltage, ratio of current peak to steady short-circuit current, the reserve voltage, and the recovery time being explained. The second part deals with the relative economy of single and multi-operator welding sets, detailed figures being given to show that the running costs depend entirely on operating time. Finally, a new high-frequency a.c. welding machine is described, which is especially suitable for welding thin plate and with which difficulties due to magnetic deflection of the arc are eliminated.—H. W. G. H.

Resistance Welding. L. H. Frost (*Welding Eng.*, 1936, **21**, (5), 47–48; (6), 44–46).—A continuation of previous articles (see *Met. Abs.*, this vol., p. 278)

dealing with contact tip design and materials. The welding of coated materials—tinplate, terne plate, &c.—and of brasses, bronzes, and aluminium is also considered. For the last, ball-ended contact tips of special alloy are thought essential. Transformer capacities approximately 5 times those for steel are required.—H. W. G. H.

Accurate Time Control for Resistance Welding. R. T. Gillette (*J. Amer. Weld. Soc.*, 1936, **15**, (6), 6–8).—The advantages of thyratron control for seam welding are enumerated, and its application in the manufacture of refrigerator parts is described.—H. W. G. H.

Jigs and Fixtures for Resistance Welding Machines. H. C. Cogan (*J. Amer. Weld. Soc.*, 1936, **15**, (7), 9–15).—Thirteen rules for the design and operation of jigs and fixtures are given, and examples of applications to spot-, seam-, flash-, and projection-welding are described.—H. W. G. H.

Concerning Some Difficulties in the Practice of Spot-Welding. R. de Longcamp (*Bull. Soc. Ing. Soudeurs*, 1936, **7**, (39), 2123–2130).—Variations in the quality of spot welds are shown to be due, not only to avoidable variations in electrode pressure, area of contact, cleanliness of surface, &c., but also to differences of resistivity and energy losses which are not completely compensated by such devices as the wattmeter control. A new method of current control, based on the reduction of resistivity of the sheets to be joined at the moment of fusion, is thought to be of great interest. The use of small contact tips, of special material, is recommended in preference to the large tips commonly employed. The need for a reliable non-destructive test for spot welds, and for further research on the design of transformers, is emphasized.—H. W. G. H.

The " Wist " Process of Electric Welding. L. Kirste (*Aéronautique*, 1936, **18**, (206), 149–150).—In this process a long, pointed flame, having a temperature of 3500°-4500° C., is produced by blowing water gas or alcohol vapour through an arc between concentric carbon electrodes. The high temperature of the flame enables very high welding speeds to be attained.—J. C. C.

" The Invisible Ray." It Welds—It Smelts. T. W. Lippert (*Iron Age*, 1936, **138**, (8), 26–31).—A critical description of Antonio Longoria's electromagnetic process of welding thin non-ferrous metal strips.—J. H. W.

Simple Fixtures Assure Correct Welding. Fred B. Jacobs (*Welding Eng.*, 1936, **21**, (7), 26–28).—Jigs for welding small frames, boxes, and heavy rings are illustrated and described, with particular reference to the saving of time effected by careful design of the operating mechanism.—H. W. G. H.

A Method of Determining the Properties of Welding Generators. L. A. Ferney (*Welding Ind.*, 1936, **4**, (6), 216–218).—A theoretical consideration of the " fictitious resistance " of welding generators—the ratio of the open circuit voltage to the peak short-circuit current.—H. W. G. H.

Qualification and Classification of Welders. —— (*Rev. Soudure Autogène*, 1936, **28**, (269), 2–9 ; and *Soudure et Oxy-Coupage*, 1936, **13**, (74), 297–304).—A programme prepared by the Institut de Soudure Autogène for the classification and certification of welders, who are divided into the following categories : professional welders (blowpipe or arc), specialized welders (blowpipe, arc, or resistance), and assistants. The qualifications required and the tests to be passed for the first category are described.—H. W. G. H.

Tests for the Selection of Operators of Welding Equipment (Tentative). —— (*Internat. Acet. Assoc. Oxy-Acetylene Cttee. Publ.*, Section 6, **1935**, 18 pp.).—Suitable test-welds and tests are suggested for ferrous materials, copper, bronze, aluminium, nickel, and Monel metal. The tests recommended are : tensile, on a test-piece with the weld reinforcement retained ; nick-break test, the sample being held in a vice and struck with a hammer ; free-bend test, on a machined specimen ; and backward bend test, to stretch the metal at the bottom of the vee.—H. W. G. H.

XXI.—INDUSTRIAL USES AND APPLICATIONS

The Introduction of Aluminium into the Norwegian Fish Preserving Industry. —— Nickelsen (*Aluminium*, 1936, **18**, (6), 234–237).—Aluminium cans have recently been used for packing sild and brisling as well as other fish by Norwegian packers. The cans do not become blackened internally, impart no smell or taste to the fish, are more readily opened than tinplate cans, and are much lighter. In 1935 over 12 million cans were used equivalent to over 300 tons of aluminium. Autoclaves, cooking boilers, and sterilizers have also been made of aluminium with very satisfactory results in service.—A. R. P.

Aluminium : a German Material for the Construction of Apparatus. H. Röhrig (*Chem. Fabrik*, 1935, 487–489).—The suitability of aluminium for different apparatus and methods to increase its corrosion-resistance and to facilitate welding are discussed.—S. G.

Aluminium and Aluminium Alloys in the Chemical Industry. Fritz Ohl (*Werkstoffe u. Korrosion* (Suppt. to *Chem. Apparatur*), 1935, **10**, (10), 45–47).— Aluminium is corrosion-resistant to many organic substances. Addition of silicon increases, and copper, zinc, or nickel decrease, the resistance to corrosion.—L. A. O.

Aluminium in the Building Industry. Arne Bruick (*Aluminium*, 1936, **18**, (6), 237–241).—Recently many new shops and offices in Norway have been provided with exterior and interior fittings of aluminium or its alloys ; examples of shop fronts, doors, staircases, counters, kiosks, &c., are illustrated.
—A. R. P.

Italian Experience with Telephone Wires. G. Dassetto (*Aluminium*, 1936, **18**, (6), 253–256).—Tables are given showing the mechanical and electrical properties of telephone wires of bronze, steel, and Aldrey, and details are given of the methods used in mounting and joining Aldrey wires.—A. R. P.

Aluminium in Bridge Construction. Structural Applications in America. —— (*Met. Ind. (Lond.)*, 1936, **49**, (10), 234–235).—" 27 S.T.," an aluminium alloy having a tensile strength of nearly 27 tons/in.^{2} and an elongation of 12%, with a Brinell number of 118, has been adopted by the American military authorities for portable bridges. The dimensions and structural details of such bridges are described. It is proposed to re-floor Brooklyn bridge with re-designed trusses and stays in this alloy. In the case of a bridge in Pittsburg a saving of 700 tons in weight was effected by replacing wrought iron and timber by aluminium. It is suggested that old bridges, costly to rebuild, can be modernized economically by the extended use of similar alloys. [*Note by abstractor :* Methods and costs of protection against corrosion are not referred to in the article.]—J. E. N.

Aluminium in the Service of Transportation. Alexander Klemin (*Trans. Electrochem. Soc.*, 1936, **69**, 47–54).—Address on the occasion of the 50th anniversary of the discovery of Hall's electrolytic process for producing aluminium.—S. G.

Aluminium in Norwegian Transport. Arne Bruick (*Aluminium*, 1936, **18**, (6), 242–249).—Many interesting examples of the use of aluminium alloys in the coachwork of road and railway vehicles are illustrated by diagrams and photographs, and details of their dimensions, weight, and performance are given in the text.—A. R. P.

The Design of the Coaches for Suburban Services of the Chemin de Fer de l'Est. —— Poncet and —— Forestier (*Rev. gén. Chemins de Fer*, 1936, **55**, (2), 91–104).—An estimated reduction of 23% has been effected in the weight of the railway coaches on the Est suburban services, partly by the adoption of welded tubular construction, and to a great extent by the substitution of light alloys for steel. Roofing and much of the interior and exterior panelling will be

of Almasilium sheet; sliding doors will be of Duralinox (an aluminium-base alloy containing 5·5–7% magnesium); the smaller stressed members will be of Duralumin : magnesium-base materials will be used in decorative metal work, and an aluminium–copper alloy will be used for racks, rails, handles, &c., which are normally painted.   Light alloy channels are used in the flooring.—P. R.

Lautal as Material for the Construction of Airplanes.   P. Brenner (*Light Metals Rev.*, 1936, **2**, (24), 448–450).—Summarized from *Luftfahrtforschung*, 1928, **1**, (2), 35 ; see *J. Inst. Metals*, 1928, **39**, 713, and 1929, **42**, 603.—L. O.

*Technological Developments of the Curtiss–Wright Coupé.   Albert E. Lombard, Jr. (*J. Aeronaut. Sci.*, 1936, **3**, (8), 267–275).—Tests are described on a series of 15 panels of Alclad sheet, in which various types of stiffeners were used.   A " formed-up " stiffener of thin Alclad sheet proved the most satisfactory, two extruded sections of " 24 S.T." alloy being next in order of merit.   The alloy would prove stronger than Alclad if used as thin sheet, but its use in this form is inadvisable on account of its liability to corrosion.—P. R.

Aluminium Sand- or Die-Casting (Not Suitable for Pistons).   —— ((*Brit.*) *Air Min. Specification* No. **D.T.D. 287**, 1935, 3 pp.).—Covers the materials generally known as Ceralumin B and N.A. 111 alloy.—S. G.

Aluminium Alloy Sand or Die-Castings (Not Suitable for Pistons).   —— ((*Brit.*) *Air Min. Specification* No. **D.T.D. 298**, 1936, 3 pp.).—Covers the material generally known as N.A. 225/W91 alloy.—S. G.

Aluminium Alloy Sand or Die-Castings (Not Suitable for Pistons).   —— ((*Brit*). *Air Min. Specification* No. **D.T.D. 304**, 1936, 3 pp.).—Covers the material generally known as N.A. 225/T92 alloy.—S. G.

Wrought Light Aluminium Alloy Sheets and Strips.   —— ((*Brit.*) *Air Min. Specification* No. **D.T.D. 206**, 1936, 8 pp.).—Covers the alloy generally known as Hiduminium R.R. 56 (sp. gr. $\ngtr$ 2·80).—S. G.

Soft Aluminium Alloy Sheets and Strips.   —— ((*Brit.*) *Air Min. Specification* No. **D.T.D. 292**, 1936, 4 pp.).—Covers the alloy generally known as N.A. 57 S (sp. gr. $\ngtr$ 2·85).—S. G.

Aluminium Alloy Bars, Extruded Sections, and Forgings.   —— ((*Brit.*) *Air Min. Specification* No. **D.T.D. 293**, 1935, 7 pp.).—Covers the materials generally known as Ceralumin F, N.A. 15 S alloy, and Duralumin T ; sp. gr. not greater than 2·85.—S. G.

Aluminium Alloy Bars, Extruded Sections, and Forgings.   —— (*Amendments* (*Brit.*) *Air Min. Specification* No. **D.T.D. 293**, Amendment No. 1, 1936, 1 p.).—Clause 17(*a*) is deleted and a new paragraph regarding hardness requirements is substituted.—S. G.

Seven Per Cent. Magnesium–Aluminium Alloy Tubes (Annealed).   —— (*Provisional* (*Brit.*) *Air Min. Specification* No. **D.T.D. 190**, 1936, 4 pp.).—Covers the material generally known as M.G. 7 alloy (sp. gr. = 2·63).—S. G.

Beryllium–Copper Used in Electrical Switch Spring.   A. L. Riche (*Trans. Electrochem. Soc.*, 1936, **69**, 493–494).—See *Met. Abs.*, this vol., p. 179.—S. G.

Wear Resistance.   —— (*Automobile Eng.*, 1936, **26**, (348), 319–320).—New methods of chromium-plating camshafts, crankshafts, and cylinder bores are considered, and the reasons involving the adoption of such methods, the procedure in carrying out the new methods, and the types of deposits obtained are discussed.   Consideration is also given to the grinding of chromium deposits to the speeds used, and to the most satisfactory type of grinding wheels.   Graphs are given showing the rate of wear of cylinder liners so treated with the rates of wear of different cylinder materials.—J. W. D.

Anti-Friction Lead–Copper Alloys.   M. A. Ricard (*Cuivre et Laiton*, 1936, **9**, (171), 127–130 ; and *Rev. Fonderie moderne*, 1936, **2**, (Feb.), 72–73).—Read before the Société des Ingénieurs de l'Automobile.   A summary of the general properties of these alloys, their special characteristics as anti-friction metals,

the conditions under which they are employed and examples from actual use. The development of these alloys on a wider scale is discussed.—W. A. C. N.

Magnesium Alloy Sheets (Suitable for Welding). —— ((*Brit.*) *Air Min. Specification* No. **D.T.D. 120 A**, 1936, 2 pp.).—Replaces Specification No. D.T.D. 120; covers the materials generally known as Elektron AZM and Magnuminium alloy; (sp. gr. $\ngtr$ 1·83). Only simple bending or shaping operations can be made on this material without heating. Most operations can be successfully performed at a temperature of approx. 300° C., but the material must not be heated above 350° C.—S. G.

A New Hard Metal [Titanit-U]. H. Strauch (*Tech. Zent. prakt. Metall-bearbeitung*, 1935, **45**, (5/6), 132).—The use of Titanit-U as a cutting medium is described.—W. A. C. N.

*****Greenhouse Wires and Pipes Galvanized with Zinc React with Sulphur Dioxide to Form Soluble Zinc Salts.** K. J. Kadow, W. A. Ruth, and H. W. Anderson (*Phytopathology*, 1936, **26**, 609–610; *C. Abs.*, 1936, **30**, 5353).—Several instances of injury to greenhouse crops have been traced to the toxic action of soluble zinc salts which were added to the soil through the dripping of condensed moisture from wires and pipes corroded by sulphur dioxide fumigation.
—S. G.

New Fields for Zinc Die-Castings. Herbert Chase (*Met. Ind. (Lond.)*, 1936, **49**, (1), 11–13).—See also *Met. Abs.*, this vol., p. 282. Compares the present position of zinc die-casting in this country and America and indicates lines of future development. Large numbers of motor-car radiator grilles, up to 23 lb. in weight each show the size and intricacy of work now done. On the other hand machines capable of casting 1000 times per hr. produce small parts economically. Domestic applications are discussed, and the combination of die-castings with plastics is mentioned.—J. E. N.

The Uses of Non-Ferrous Metals. A. R. Powell (*Financial News*, **1936**, April 20, 9–10).—An account of the effect of metallurgical progress in extending the scope and nature of the uses of non-ferrous metals and alloys.—H. H.

Bearings on the German National Railway. —— Garbers (*Organ Fortschritte Eisenbahnwesens*, 1936, **91**, (14), 295–312).—An account of the design and lubrication of bearings is followed by a discussion of the qualities desirable in shells and bearing surfaces. The high brasses are preferred as shell-material, but recent restrictions on the use of copper have led to the introduction of steel-reinforced brass; this has been effected without modification of the actual shape of the shell. The use of copper–nickel–aluminium alloys is not advised, as causing excessive contamination in remelted scrap. No completely satisfactory bearing metal for railway use is known. The properties and method of running of the lead–alkali metal bearings in general use for coaches and of the tin-base white metal mainly used in locomotive bearings are described: an account is also given of the centrifugal casting and die-casting of bearings. Photomicrographs illustrate the influence of rotation speeds on centrifugal castings. The standard methods of testing are fully described.—P. M. C. R.

The Lining of Bearings. Edmund R. Thews (*Mech. World*, 1936, **99**, (2575), 465–466).—Some of the most important reasons for lining failures are discussed under the headings: (1) proper preparation of bearing surfaces; (2) sandblasting, grinding, brushing, scratching, &c.; (3) cleaning of mechanically-treated surfaces; (4) etching of contact surfaces; (5) tinning of contact faces; (6) lining operation.—F. J.

Replacing Metals by Resins. —— (*Wool Record*, 1935, **48**, 1001–1005). —Laminated resinoid tubing has proved suitable for the construction of static eliminator bars for removing electrical charges developed in carding, warping, and weaving.—S. G.

XXII.—MISCELLANEOUS

What Does the Recent Development in the Technique of Non-Ferrous Metallurgy Offer to the Iron Metallurgist? G. Masing (*Stahl u. Eisen*, 1936, **56**, (16), 457–465).—A general review of the progress of non-ferrous metallurgy and the points of contact with work on iron and steel, Among the subjects thus reviewed are : transformations, equilibrium diagrams, aluminium and its alloys, degassing, copper and its alloys, zinc ferromagnetic alloys, metallic coatings.—W. A. C. N.

Advance in Scientific Metallurgy. (Sir) Robert Hadfield (*Engineer*, 1936, **161**, (4196), 626–627).—Mainly a review of ferrous metallurgical progress, with special reference to alloy steels.—R. Gr.

Chemical and Metallurgical Industries in India. E. Spencer (*Indust. Chemist*, 1936, **12**, 254–256).—S. G.

The Non-Ferrous Mining and Metallurgical Industry in Spain. E. Jimeno and F. R. Morral (*Metals and Alloys*, 1935, **6**, (11), 317, 321).—S. G.

The Rôle of Patents in Modern Metallurgy. Anthony William Deller (*Metals and Alloys*, 1935, **6**, (11), 303–306).—S. G.

Charles Martin Hall. Francis C. Frary (*Trans. Electrochem. Soc.*, 1936, **69**, 39–43).—Address on the occasion of the 50th anniversary of the discovery of Hall's electrolytic process for the production of aluminium.—S. G.

The Early Beginnings of the Aluminium Industry. Arthur V. Davis (*Trans. Electrochem. Soc.*, 1936, **69**, 54–60).—Address on the occasion of the 50th anniversary of the discovery of Hall's electrolytic process for producing aluminium.—S. G.

The Aluminium Industry of Norway. Arne Bruick (*Aluminium*, 1936, **18**, (6), 231–233).—A brief history is given of the development and present position of the aluminium industry in Norway.—A. R. P.

Fifty Years' Progress in Research. Frederick M. Beckett (*Trans. Electrochem. Soc.*, 1936, **69**, 43–47).—Address on the occasion of the 50th anniversary of the discovery of Hall's electrolytic process for producing aluminium.—S. G.

The Operation of a Modern Research Laboratory in the Development of Aluminium Alloys. A. von Zeerleder (*Aluminium*, 1936, **18**, (7), 297–298).— A very large number of patents for aluminium alloys have been granted in most industrial countries but very few of the alloys have had any extensive practical applications. The reasons for this state of affairs are discussed and proper methods of testing new alloys are described.—A. R. P.

Aluminium and Magnesium. —— (*Financial News*, 1936, (April 20), 16, 18).—Particulars are given of the world's producers, their capacity and organization, and estimated production statistics.—H. W. G. H.

The Metallurgy of Silver and Mercury. A. Gálvez-Cañero (*IX Congr. internat. quim. pura applicada, Madrid*, 1934, **3**, 104–138 ; *C. Abs.*, 1936, **30**, 5535).—A historical review of Spanish metallurgical research and development of silver and mercury.—S. G.

Alloy Steel Metals [Vanadium, Titanium, Tungsten, Cobalt]. O. W. Roskill (*Financial News*, 1936, (April 20), 15–16).—Gives the principal uses of the metals and brief details of their sources and production.—H. W. G. H.

Growth of the [British] Empire Zinc Industry. (Sir) Robert Horne (*Financial News*, 1936, (April 20), 12–13).—A review of the progress of the scheme to develop an Empire zinc industry smelting Empire ore and to make the Empire independent of foreign supplies of zinc.—H. W. G. H.

The European and World Zinc Situation in 1935. O. W. Roskill (*J. Amer. Zinc Inst.*, 1936, **17**, 111–119).—S. G.

The Purposes and Objectives of the American Hot-Dip Galvanizers Association. T. M. Gregory (*J. Amer. Zinc Inst.*, 1936, **17**, 105–108; discussion, 108).—S. G.

Modern Research Methods. Clyde E. Williams (*J. Amer. Zinc Inst.*, 1936, **17**, 57–60; and (condensed) *Met. Ind. (Lond.)*, 1936, **49**, (8), 187–188).—J. E. N.

Accidents Caused by Arsine in Industry. G. Batta, J. Firket, and E. Leclerc (*15me. Congr. chim. indust. (Bruxelles, 1935)*, **1936**, 897–920; *C. Abs.*, 1936, **30**, 5677).—The symptoms of arsine intoxication, according to its gravity, are described; the order of magnitude of the toxic doses is indicated; methods proposed for the detection of arsine are reviewed; experiments on the evolution of arsine during the recovery of cadmium and during pickling are described, and measures are suggested for preventing this professional hazard. When arsenious compounds are precipitated by zinc powder in solutions containing approx. 5 grm. sulphuric acid per litre, arsine can be evolved in toxic amounts; the presence of sulphates in the solution decreases the evolution of arsine, and cadmium sulphate exerts an inhibiting influence. Increasing the acidity or increasing the temperature favours evolution of arsine. Precipitated arsenic sludge, when introduced in fresh acid solution, can be reconverted into arsine on addition of zinc dust. Cadmium seems to act as a retarder on the evolution of arsine when the acidity of the solution is low, but not in strongly acid solution. In *pickling zinc* by arsenic-containing acid, the evolution of arsine can reach 40 grm. in 30 minutes per sq. m. of zinc attacked.—S. G.

Reading Technical Matter. F. Young (*Mech. World*, 1936, **99**, (2579), 566).— A technique for the effective and speedy reading and comprehension of technical matter is described. A simple apparatus is used as an aid to concentration, and annotation and analysis advocated as aids to memory and future reference.—F. J.

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[The draft code is intended to be reviewed in the light of comments and criticism, which are invited.]

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    [Contents : A. Hilpert u. W. Adrian, " Zehn Jahre deutscher Schweisstechnik " ; W. Prox, " Erkenntnisse und Erfolge bei der elektrischen Schweissung " ; J. Müller, "Schweissbarkeit von Stählen höherer Festigkeit " ; H. Schottky, " Das Schweissen der warmfesten und hitzebeständigen Stahllegierungen " ; K. L. Zeyen, " Das Schweissen von Stählen grosser Festigkeit " ; L. Rostosky, " Löten und Schweissen der Leicht-metalle " (*Met. Abs.*, 1935, 2, 635) ; E. Lüder, " Schweissen und Löten von Leicht-metallen " (*Met. Abs.*, 1935, 2, 485) ; H. Kalpers, " Korrosionswiderstand von Schweiss-ungen " ; H. Blomberg, " Behälterschweissung nach dem Arcatom-Verfahren " ; H. Türcke, " Schweissen bei Maschinen- und Kesselschäden " ; W. v. Bleichert, " Klein-maschinen für die Lichtbogenschweissung " ; R. Malisius, " Brennschneiden und Schweissen von Maschinenteilen " ; K. Schreyer, " Gestalten und Fertigen geschweisster Vorrichtungen" ; A. Matting, " Schweisstechnische Oberflächenbehandlung zur Erhöhung der Verschleissfestigkeit " ; A. Matting, " Schweisstechnische Oberflächenbehandlung als Korrosionsschutz " ; A. Matting, " Schweisstechnische Oberflächenbehandlung zur Härtesteigerung " ; A. Matting, " Schweisstechnische Oberflächenbehandlung zur Herstellung von Überzügen " ; E. Rüter, " Festigkeitseigenschaften von Proben aus einer elektrisch geschweissten Trommel " ; W. Jamm u. O. Weinrich, " Untersuchung einer elektrisch geschweissten Hochdrucktrommel " ; F. Lehmann, " Verstellbares Messgerät für Kehlschweissung " ; G. Czternasty, " Festigkeitseigenschaften einer hochwertigen Lichtbogenschweissung."]

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NEW PERIODICALS.

Journal of the New Zealand Institute of Chemistry. Published by the New Zealand Institute of Chemistry, Wellington, New Zealand. Vol. 1. (Jan. 1936.) 2s.

Revue de la Faculté des Sciences de l'Université d'Istanbul. (Istanbul Universitesi fen Fakültesi Mecmuasi.) Published quarterly by the Faculty of Sciences of the University of Istanbul. Vol. 1, No. 1. (1936.) Obtainable from Akademische Verlagsgesellschaft m.b.H. 8 Turkish Liras.

XXIV.—BOOK REVIEWS

(Continued from pp. 333–336.)

Métallurgie, a l'usage des Ingénieurs, Maîtres de forges, Directeurs et contremaîtres d'usines métallurgiques de fonderies de métaux, &c. Par R. Cazaud. (Agenda Dunod.) 52e. édition. 9·5 × 14·5 cm. Pp. xxiv + 323 + xcvi. 1936. Paris : Dunod. (Rel. pégam., 24.40 francs ; France and colonies, 20.85 francs.)

This is a small handbook in which a multitude of metallurgical data 's collected. The contents of its five sections may be summarized as follows : (1) fuels, refractories, furnaces heated by gas and electricity ; (2) mechanical testing, thermal analysis, corrosion tests, microscopical and macroscopical examination ; (3) pyrometric control, thermo-chemical treatment (cementation), general heat-treatment ; (4) ferrous metallurgy ; (5) non-ferrous metals and alloys. A section of 87 pages at the end of the book is devoted to a statement of legislation dealing with the control and protection of labour in France. This includes conditions governing apprenticeship, forms of contract, distribution of labour, strikes, professional classes, accidents, dangerous trades, hygiene, employment of foreign workers, factory inspection, night work, and employment of juveniles.—W. A. C. NEWMAN.

Elementary Metallurgy for Engineers. By G. F. C. Gordon. Second Edition, Revised and Enlarged. Post 8vo. Pp. ix + 166, with 27 illustrations. 1936. London : Constable & Co., Ltd. (8s. 6d.)

The second edition of this useful book for young engineers and for those of more advanced knowledge has been revised and brought up-to-date to the extent of an additional ten pages. The chapter on the testing of materials has been augmented by notes on proof testing, creep tests, and a reference to the Vickers diamond hardness tester. A description of the cupola and of recent improvements in the cupola is added with advantage to the chapter on iron, while the chapter on the production of structural steels is improved by additional reference to basic Bessemer steel, electric steel furnaces, and to the production of clean steel free from non-metallic inclusions. A short paragraph on alloys, suitable for heating elements, and further information on high-tensile brass propellers are useful additions to the chapter on non-ferrous metals.

The revision and additions enhance considerably the value of the book in presenting to engineering students modern metallurgical knowledge in simple and brief outline.

—J. W. DONALDSON.

Foundry Calculations and Drawing. By Leslie Booth. (Griffins' Industrial Textbooks. Edited by P. Longmuir.) Med. 8vo. Pp. ix + 133, with 71 illustrations. 1936. London : Charles Griffin and Co., Ltd. (4s. net.)

The sub-title of this book is " A Handbook for Moulders, Pattern Makers, and Students of Foundry Practice," and it certainly contains much that will be of real value to the student of foundry practice. To the average moulder with little or no scientific training, and whose mathematics are usually limited to simple arithmetic, it is not sufficiently elementary or explicit to be of any real help for private study. In the first introductory chapter he will find simple multiplication and division followed by logarithms and the use of the slide rule. In the second chapter he progresses from simple geometrical figures to trigonometry and solution of triangles. Such rate of progress surely implies some previous knowledge of this branch of mathematics.

In the foreword the editor says, " Intimate contact with foundry workers indicates a natural reluctance to work out an original sum," and this handling of the problems does not appear likely to offer much encouragement in overcoming this reluctance. The chapters on the con-

struction and use of graphs, sketching and drawing, weight estimation and calculations for foundry charges are written in the same concise style.

This little volume will be excellent to supplement a course of lectures on the subject but is too condensed to meet the requirements of all but the most exceptional moulders and pattern makers.—J. E. NEWSON.

Freiformschmiede. Erster Teil—**Grundlagen, Werkstoff der Schmiede, Technologie des Schmiedens.** Von F. W. Duesing und A. Stodt. Zweite, völlig neu bearbeitete Auflage des zuerst von P. H. Schweissguth bearbeiteten Heftes. (Werkstattsbücher für Betriebsbeamte, Konstrukteure und Facharbeiter. Herausgeber Eugen Simon. Heft 11.) Med. 8vo. Pp. 60, with 161 illustrations. 1934. Berlin : Julius Springer. (R.M. 2.)

This is the second edition of one of a series of technological handbooks which are remarkable for their clarity and comprehensiveness. The first section deals with the fundamental principles of forging in particular and of the flow of metals under compression due to dynamic forces in general. It is mostly abstracted from Siebel's book on a similar subject. In the second section steel suitable for forging is discussed. The effect of the structure on the course of deformation in all its phases is carefully detailed. There follow descriptions of various forging methods—forming, thinning, cutting, bending, twisting. A short chapter on welding is included. Illustrations to the number of 161 assist greatly in amplifying the text.

—W. A. C. NEWMAN.

Der Facharbeiter im Flugzeugbau. Von Richard Hofmann. Cr. 8vo. Band 4 : **Der Leichtmetall-Schlosser.** Pp. 112, with 82 illustrations. 1935. (R.M. 2.10.) Band 5 : **Der Flugzeug-Schweisser.** Pp. 89, with 53 illustrations. 1936. (R.M. 2.20.) Halle a. S. : Carl Marhold.

Der Leichtmetall-Schlosser.—The light alloys commonly used in Germany for aircraft work are enumerated, and the most suitable methods of machining and forming them are described. Drilling and tapping, milling, shearing, sawing, bending, folding, pressing, and riveting are dealt with. Tables of physical properties and machining data form an appendix.

Der Flugzeug-Schweisser.—The principles of oxy-acetylene, arc, and resistance welding of light metals are explained. Several proprietary soldering and brazing materials are described and instructions are given for using them. Various acetylene generators, distribution, and controlling devices are also described. Appended are tables of welding data.

These booklets are intended for the use of craftsmen who have not had previous experience in aircraft work, and will supply them with useful and up-to-date information. It is necessary, however, to issue the warning that undue emphasis is sometimes laid on matters of secondary importance.—H. W. G. HIGNETT.

Secondary Copper : Its Production, Consumption, and Market Effect. By Percy E. Barbour. Med. 8vo. Pp. vii + 85, with 11 illustrations. 1936. New York : Mining and Metallurgical Society of America, 90 Broad St. ($1.50.)

In 1931 Mr. Barbour presented a paper to the A.I.M.E. on " The Effect of Secondary Copper on the Metal Market," in which the official American statistics relating to primary and secondary copper were examined from a new angle, directing attention to the correct interpretation of many of the relevant facts and exploding a number of fallacies. Such a paper naturally aroused considerable interest and discussion, and the present work carries the investigation a stage further in the light of the present industrial situation. It is essentially a critical analysis of the official statistics of the secondary copper position in the United States, and the author is at some pains to distinguish between secondary metallic copper and secondary copper-bearing alloys such as brass, which return to industry unchanged in the alloyed state, but which have been included as secondary copper in the official figures. He suggests that the following definition would help to give a truer perspective : " Secondary copper is that copper metal reclaimed from scrap returned by industry to be retreated and refashioned into marketable forms."

Adopting this classification the author then reviews the production of secondary copper and its influence on the copper market, and directs attention to the increasing amounts of secondary metal now being handled by primary plants. Amongst the logical, well-reasoned conclusions which he reaches from his analysis, the following are of especial interest : " the quantity of secondary copper produced is involuntary and depends entirely on the progress of industry as a whole," and " Secondary copper has no effect on the market price of copper except in times of recession in industry as a whole and then only of minor importance." The price at which this little book is offered to non-members of the Society is very reasonable, and it is worthy of careful study by all interested in the production or buying of copper.

—J. E. NEWSON.

Handbuch der Dosenfertigung. Von Waldemar Friebel. 15 × 21 cm. Pp. 100, with 121 illustrations. 1936. Berlin : V.D.I.-Verlag G.m.b.H. (Br., R.M. 10 ; V.D.I.-Mitgl., R.M. 9.)

Technical literature contains little in the way of comprehensive reviews of the manufacture of the tinplate can, although the number of cans made throughout the world every year, for the conservation of food alone, amounts to many thousand millions. The present book, dealing with an important and expanding industry on which relatively little has been written, is therefore to be welcomed.

The book begins with a chapter on tinplate, with special reference to its requirements for can-making. The testing of tinplate is briefly described. Then follow chapters on the formation of the can body and soldering of the side seam, the stamping of the can ends, application of sealing compositions, and production of the double seam. Special consideration is given to the methods for examining and testing the seams of finished cans, and the main causes of faults are traced. Deep-drawn cans are dealt with in a separate chapter.

The treatment of the subject-matter is essentially practical, and the book is clearly intended to be used by those in charge of operations in the industry. The numerous illustrations and tables make the arguments and descriptions of processes particularly easy to follow, and there is no doubt that the book will be of the greatest use, not only to practical technicians, but also to all who are interested in the tinplate, can-making, and canning industries.—E. S. HEDGES.

Sheet Metal Workers' Manual. By L. Broemel. Fcap. 8vo. Pp. 552, with numerous illustrations. 1935. Chicago, Ill. : Frederick J. Drake and Co. ($2.00.)

This book divides itself into three main parts : the first, comprising sections 1 to 6, consists of a description of the machinery and tools employed in sheet metal working and a course of practical instruction. The second part deals with the various welding methods (sections 7, 8, and 9), hand-forging (section 10), and brazing (section 11). The remaining sections are devoted to pipe bending, the properties of metals and alloys, practical geometry, and useful tables.

Although the descriptions of machinery provide opportunities for advertisement, which the author cannot resist completely, nevertheless they are clear and informative. The welding sections are not up-to-date ; rightward welding, deoxidized copper, synchronous control of resistance welders, are notable omissions. The metallurgical section is too elementary and too brief to be of value. In sum, however, this book should be found useful by metal-working apprentices.—H. W. G. HIGNETT.

Industrielle Elektrowärme. Herausgegeben von der Wirtschaftsgruppe Elektrizitätsversorgung bearbeitet von —— Masukowitz unter Mitarbeit von —— Knoops. Teil 1.—**Entwicklung, Eigenschaften Wirtschaftlichkeit, Bedeutung, Bauformen.** 2. unveränderte Auflage. Pp. 1–63. Berlin : Arbeitsgemeinschaft zur Förderung der Elektrowirtschaft, Buchenstrasse 5 (W. 35).

This admirable little book is issued for the information of prospective furnace users by an Association in Germany for the promotion of electric heating. It has been prepared by two well-known authorities on electric furnace practice.

The development of electric heating is well portrayed by means of graphs and statistics. Then follows a description of the various types of plant for melting, heat-treatment, and electro-thermal processes, while the advantages of these over fuel-fired methods of heating are cleverly illustrated by contrasting photographs and effective diagrams. The reader is also made acquainted with the principles of electric heating such as different types of heating elements, the various forms of insulation, methods of applying inductive heating, and so on.

The book does not aim to be anything more than an introduction to the subject—an object which it admirably fulfils. It is illustrated with some 99 photographs and diagrams while the printing and paper are good.—A. G. ROBIETTE.

Étude des flammes de soudure, précédée d'un exposé sur les chaleurs spécifiques des gaz aux températures élevées. Par D. Séférian. Préface de G. Ribaud. Med. 8vo. Pp. 64, with 15 illustrations. Paris : Institut de Soudure autogène, 32 Boul. de la Chapelle (18e). (Broché, 12 francs.)

The first section of this booklet explains the thermodynamic calculation of high flame temperatures, emphasizing the value of recent work by Ribaud (who contributes a preface to the book) and Montagne on the specific heats of gases at high temperatures. Using the data provided by this work, and the results of spectrographic determination of the degree of dissociation of the products of combustion, Dr. Séférian calculates the temperatures of the oxy-

acetylene, atomic hydrogen, oxy-hydrogen, oxy-methane, and oxy-butane flames, comparing his results with those obtained experimentally and theoretically by other workers. A valuable summary of the practical implications and a bibliography of 36 references are given. The author concludes by pointing out the peculiar advantages of the oxy-acetylene flame for welding and paying a typically graceful tribute to the pioneers in its development.

It need scarcely be mentioned that no welder's library is complete without this little book.

—H. W. G. HIGNETT.

Forschungsarbeiten auf dem Gebiete des Schweissens und Schneidens mittels Sauerstoff und Azetylen. Zehnte Folge. Herausgegeben im Auftrage des Deutschen Azetylenvereins von W. Rimarski. 21×30 cm. Pp. 104, illustrated. 1935. Halle a. S. : Carl Marhold. (R.M. 4.)

This tenth collection of research reports contains the following papers (printed in German), which have previously been abstracted : " Welding of Zinc Sheet," by Hans A. Horn (*Met. Abs.*, 1935, **2**, 447); " Lead Welding by the Oxy-Acetylene Flame," by F. Schulze and J. Staebler (*Met. Abs.*, 1935, **2**, 363); " Researches on Jointing Aluminium to Other Metals," by H. Holler and —— Maier (*Met. Abs.*, 1935, **2**, 447); and " X-Ray Examination of Gas-welded Copper Fireboxes," by W. Grimm (*Met. Abs.*, 1935, **2**, 111).

In addition, there are papers on ferrous welding and on explosion risks in the use of acetylene. This volume, like its predecessors, is indispensable to all welders who have no access to the back numbers of *Autogene Metallbearbeitung.*—H. W. G. HIGNETT.

La Diffraction des Électrons dans ses Applications. Par Jean J. Trillat. (Actualités scientifiques et industrielles, No. 269.) Roy. 8vo. Pp. 59, with 6 plates and 13 illustrations in the text. 1935. Paris : Hermann et Cie. (18 francs.)

This monograph follows the author's equally commendable work " Les preuves expéri-mentales Mécanique Ondulatoire. Diffraction des électrons et des corpuscules matériels," published in the same series in 1934. M. J. J. Trillat, having himself contributed largely to the progress of this new technique, has in this work given us a clear and concise account, which affords a valuable introduction to a subject of great importance to the metallurgist, for in the application of electron diffraction we have an unrivalled method for the study of surface processes such as tarnishing and polishing, and a useful tool in the study of thin metallic films. The electron beam, in fact, besides giving independent confirmation of the results of X-ray investigation, supplies just those opportunities in the study of matter which are denied to the older method.

It is the first half of the book which is of particular interest to the metallurgist, since this is concerned with the general experimental technique of electron diffraction and its application to the study of metallic surfaces and thin metallic films. The remaining three chapters deal with the applications to the study of carbon, organic compounds, and free molecules (gases and vapours), and with the diffraction of slow electrons. The treatment is general and qualita-tive in the main, while for those who would proceed to a deeper study of the subject there is a useful bibliography at the end of the book.—PETER W. REYNOLDS.

Practical Photomicrography. By J. E. Barnard and Frank V. Welch. Third Edition, Demy 8vo. Pp. xii + 352, with 121 illustrations. 1936. London : Edward Arnold and Co. (21*s.* net.)

In the third edition of this well-known book (the second edition was reviewed ten years ago, *J. Inst. Metals*, 1926, **35**), the authors have revised the text and added a considerable amount of new matter. The most interesting of the additions is perhaps the new chapter on " Photo-Micrography by Means of Ultra-Violet Light " a subject on which the authors, in view of Mr. Barnard's pioneer work, are so well qualified to write. In this chapter a brief account is given of the principles involved in the use of ultra-violet light and of the special apparatus required. The subject is illustrated by a plate of very fine photographs. A short section on the use of infra-red radiation is also now included. The book is mainly concerned with the photomicrography of biological subjects, but the photography of metal surfaces and opaque objects is also included and is dealt with more fully than in the previous edition. In this connection the authors acknowledge the assistance of H. Wrighton, and a few of his excellent photographs are used to illustrate this side of the subject.

Although not specially written for the metallurgist, this is a book which should be read and studied by all concerned with photography in connection with metallographic work.

—O. F. HUDSON.

Electrical Engineering in Radiology. A Treatise on the Nature and Function of Electrical Equipment for X-Ray Work in Medicine and Industry. By L. G. H. Sarsfield, With a Foreword by V. E. Pullin. Demy 8vo. Pp. xiii + 284, with 199 illustrations. 1936. London : Chapman and Hall, Ltd. (25*s*. net.)

This excellent book is described as a treatise on the nature and function of electrical equipment for X-ray work in medicine and in industry.

As a text-book it is made unusually interesting by the inclusion of many references to actual work done in the Radiological Research Department at Woolwich. The experience of the author in this field has resulted in the inclusion of valuable additional chapters on " Maintenance " and " Electrical Safety." So many metallurgical firms are installing X-ray equipment for the location of defects, that a text-book is necessary for the untrained worker who is called upon to manipulate such equipment. As usually happens the apparatus is chosen first, and some one with a ground-work of knowledge in physics is called upon to run the unit. This is a special line, and the new-comer will find this text-book an all-round guide to any kind of X-ray apparatus that he may be called upon to use. The chapters on " Maintenance " and " Electrical Safety " should answer all the new-comer's questions on these ever-present problems.—N. C. HYPHER.

Die Allotropie der Chemischen Elemente und die Ergebnisse der Röntgenographie. Von M. C. Neuburger. (Sammlung chemischer und chemisch-technischer Vorträge. Begründet von F. B. Ahrens. Herausgegeben von R. Pummerer-Erlangen, Neue Folge, Heft 30.) Med. 8vo. Pp. 106, with 32 illustrations. 1936. Stuttgart : Ferdinand Enke. (R.M. 9.30.)

What exactly constitutes an allotropic change ? Is the $\alpha \rightleftharpoons \beta$ magnetic transformation in iron an allotropic change or not ? These and similar questions are old favourites, and many of us will remember them in school and University lectures and examination papers. To Dr. Neuburger the critical test is a change of crystal structure—" Die verschiedene Kristallstruktur ist somit das Kennzeichen der allotropen Modifikationen." In many cases, however, the allotropic changes are at high temperatures, and X-ray crystal analyses above and below the transformation temperature have not yet been carried out. In such cases Dr. Neuburger considers a discontinuity in the graph connecting a physical property with the temperature as evidence for an allotropic transformation. In the change from α to β cobalt, for example, when hysteresis effects are absent, the graph connecting the specific resistance with the temperature shows a discontinuity at the transformation temperature, in contrast to the magnetic transformation where the curve shows an abrupt change in direction, but no discontinuity. Discretion is necessary here, since if we plot, not the resistance, but the temperature coefficient of resistance against the temperature we shall obtain a discontinuity in the curve at the magnetic transformation, and some people may argue that the difference in temperature coefficients is sufficient to justify the use of the term allotropic change. To some extent this is a matter of definition, and if we accept Dr. Neuburger's point of view we can only express our gratitude for this extremely valuable book in which the evidence for the allotropy of the elements is summarized, with more than a thousand references to original papers. Each element is discussed in turn, and the conclusion from the viewpoint described above is then given, together with details of the crystal structure, and values of the lattice constants. These are mostly taken from Dr. Neuburger's " Gitterkonstanten für das Jahr 1936 " (*Z. Krist.*, 1936, **93**, 1), and we notice that incorrect values for the interatomic distances in α-manganese are again reproduced ; the correct values are given by Bradley and Thewlis (*Proc. Roy. Soc.*, 1927, [A], **115**, 456).

We can recommend Dr. Neuburger's book wholeheartedly, both for the interest of its subject-matter, and as a convenient source of references to original papers.—W. HUME-ROTHERY.

Electrical Engineering Materials, Tables, and Properties. By Frank G. Sublet. Cr. 8vo. Pp. 147. 1936. London : Oxford University Press (Humphrey Milford). (10*s*. 6*d*. net.)

This is a collection, mainly derived from trade catalogues and data sheets, of 123 tables selected as being of value to the designer and student of electrical engineering. Wire tables, current capacity tables for conductors and certain resistance wires, tables of conversion factors, and mathematical tables occupy most of the book. There is a brief preliminary section on the general properties of some selected materials—metallic and non-metallic. The tables are clearly printed, but it is doubtful whether they contain much which is not already conveniently available in many standard " pocket-books."—J. C. CHASTON.