

METALLURGICAL ABSTRACTS

(GENERAL AND NON-FERROUS)

Volume 1

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Part 6

I.—PROPERTIES OF METALS

(Continued from pp. 225-230.)

***Change in Properties of Deformed Polycrystalline [Aluminium] During Recovery [Erholung].** M. O. Kornfeld (*Zhurnal eksperimentalnoy i teoreticheskoy Fiziki (Journal of Experimental and Theoretical Physics)*, 1933, **3**, (6), 563-566).—[In Russian.] Annealing of deformed polycrystalline aluminium in the region of "pure recovery" does not restore the original properties. The processes which take place during recovery lead to a highly stable condition characterized by a yield-point higher than that of the original material due to the residual distortion of the lattice after recovery. Laue photographs indicate that during recovery there is no noticeable shift in the boundaries between grains. It may therefore be concluded that any change in properties during recovery is determined mainly by processes taking place within the grain.—N. A.

***On the Question of the Allotropic Transition of Bismuth at 75° C.** Shin'ichi Aoyama and Gohei Monna (*Sci. Rep. Tôhoku Imp. Univ.*, 1934, [i], **23**, 52-61 [in English]; and *Kinzoku no Kenkyu*, 1934, **11**, 203-209 [in Japanese]).—Investigations by means of thermal analysis, thermal expansion, thermoelectromotive force, and oil dilatometry, indicate that the alleged allotropic transition of bismuth at 75° C. does not exist.—E. S. H.

Preparation and Properties of Cadmium. Edmund T. Richards (*Metallbörse*, 1934, **24**, 242-243).—A review.—A. R. P.

***The Electrolytic Valve Action of Columbium and Tantalum on A.C. Circuits.** D. F. Calhane and A. J. Laliberte (*Electrochem. Soc. Preprint*, 1934, (April), 287-293).—Oscillograph records are given showing the film behaviour of tantalum and columbium in dilute sulphuric acid on a.c. circuits. Tantalum gives fairly efficient rectification, but columbium is efficient only just after immersion in the acid; even at only 2.5 v. the efficiency rapidly falls almost to zero, but rises again to the original value after washing and re-immersion in the acid. Peculiarities in the oscillograph curves are discussed.—A. R. P.

†**Copper and Oxygen.** L. L. Wyman (*Gen. Elect. Rev.*, 1934, **37**, 120-129).—Following a brief description of the ordinary process for refining copper, the production of deoxidized and oxygen-free copper is discussed. Previously unpublished data by Skowronski on the effect of added metals on the conductivity of copper are given. The behaviour of various types of copper when heated in a reducing atmosphere is discussed. Deoxidized coppers react in different degrees to an oxidation-reduction cycle. Copper deoxidized with calcium boride and to which an excess of silicon has been added is not embrittled by an oxidation-reduction cycle. A number of commercial applications of the various forms of copper are discussed.—S. V. W.

***Volatilization of Silica and Copper in Steam.** J. Gillis (*Natuurwetensch. Tijds.*, 1933, **15**, 153-154; *Brit. Chem. Abs.*, 1933, [A], 1245).—Copper cylinders weighing 20 gm. lost about 50 mg. in steam at 300 atm. after 3 days.—S. G.

***Change of the Resistance of Single Crystals of Gallium in a Magnetic Field.** W. J. de Haas and J. W. Blom (*Physica*, 1933, **1**, 134-144; *Brit. Chem. Abs.*, 1934, [A], 135).—The resistance of a single gallium crystal at 10°-20° abs. and

* Denotes a paper describing the results of original research.

† Denotes a first-class critical review.

in a magnetic field of 5000–22,000 gauss shows similar behaviour to that of a single bismuth crystal. The curve of relative change in resistance against inclination of the field to the axis of the crystal is almost sinoidal at low field strengths. The results are in agreement with the rhombic crystal structure of gallium.—S. G.

***Supplement to the Paper: "Atomic Heats, Heats of Fusion, and Heats of Transformation of Gallium, Indium, and Thallium."** W. A. Roth, Ingrid Meyer, and H. Zeumer (*Z. anorg. Chem.*, 1934, **216**, 303–304).—*Cf. J. Inst. Metals*, 1933, **53**, 690. The latent heats of fusion of gallium and thallium are now given as 19.16 ± 0.01 and $5.04_0 \pm 0.01_2$ grm.-cal./grm., respectively. The heat of transformation of thallium is 0.40 ± 0.01 grm.-cal./grm.

—M. H.

The Vibration Strength of Lead. Wilhelm Stockmeyer (*Z. Metallkunde*, 1934, **26**, 93).—By bending backwards and forwards lead tubes connected with a water pipe until a leak occurred, it has been shown that the resistance to bending deformation of tubes of lead containing 1% antimony is nearly twice as great as that of soft lead tubes.—M. H.

***Thermoelectric Powers of Nickel and Nickel-Chromium Alloys Near the Curie Point.** A. W. Foster (*Proc. Leeds Phil. Soc.*, 1933, **2**, 401–405; *Brit. Chem. Abs.*, 1933, [A], 559).—The thermoelectric powers of nickel (99.5%) and nickel-chromium alloys (nickel 98.5, chromium 1%, and nickel 97.5, chromium 2%) have been measured against copper. The change in the specific heat of electrons at the Curie point is lowered very rapidly by the addition of chromium.

—S. G.

Change of the [Electrical] Resistance of Nickel Wire Under Tension at Various Temperatures. S. Arzybaschew and V. Jushakow (*Z. Physik*, 1933, **86**, 521–522).—Experiments with pure nickel under tension at various temperatures between -190° and 350° C. confirm results previously obtained with comparatively impure nickel (*ibid.*, 1930, **64**, 405).—J. S. G. T.

***On the Sorption of Hydrogen by Reduced Nickel. I.—Determination of the Quantities of the Hydrogen Adsorbed by and Diffused in Pure and Spoiled Reduced Nickel, and Determination of the Isothermal Adsorption Lines and the Heat of Adsorption.** Shun-Ichiro Iijima (*Sci. Papers Inst. Phys. Chem. Res. Tokyo*, No. 468, 1933, 285–300).—W. H.-R.

***On the Sorption of Hydrogen by Reduced Nickel. II.—Adsorption of Hydrogen by Reduced Nickel at Low Temperatures.** Shun-Ichiro Iijima (*Sci. Papers Inst. Phys. Chem. Res. Tokyo*, No. 474, 1933, 34–43).—W. H.-R.

***On the Sorption of Hydrogen by Reduced Nickel. III.—Heat-Treatment of Reduced Nickel and Its Relation to the Sorption Velocity and to the Quantity of Hydrogen Sorbed.** Shun-Ichiro Iijima (*Sci. Papers Inst. Phys. Chem. Res. Tokyo*, No. 481, 1934, 164–172).—W. H.-R.

Preparation of Metallic Praseodymium. G. Canneri and A. Rossi (*Gazz. chim. ital.*, 1932, **62**, 1160–1163; *Brit. Chem. Abs.*, 1933, [A], 360).—A maximum yield of praseodymium was obtained by the electrolysis of a fused mixture (melting point 535° C.) of 55% PrCl_3 , 27% NaCl , and 18% KCl , using a tungsten cathode and Acheson graphite anode. The temperature must be kept $< 600^\circ$ C. to avoid polarization and formation of PrO_2 . The praseodymium contains $< 0.2\%$ of other rare-earth metals and only traces of silicon and carbon. Its density is 6.765 ± 0.008 , and melting point $932 \pm 2^\circ$ C.—S. G.

The Magnetic Nuclear Moment of Rubidium Isotopes. D. A. Jackson (*Z. Physik*, 1933, **86**, 131).—J. confirms results obtained by Kopfermann (*ibid.*, 1933, **83**, 417), viz. that the nuclear spin moments of the rubidium isotopes are respectively $\text{Rb } 85, 5/2$; $\text{Rb } 87, 3/2$.—J. S. G. T.

***Preparation of Ductile Tantalum by Thermal Dissociation of Tantalum Pentachloride.** W. G. Burgers and J. C. M. Basart (*Z. anorg. Chem.*, 1934, **216**, 223–227).—Ductile tantalum can be prepared by thermal dissociation of its

chloride on a glowing nuclear wire if foreign gases are rigorously excluded. The lattice of tantalum has $a = 3.296 \pm 0.000$, Å., the specific electrical resistance is $10^4 \rho_0 = 0.124 \Omega \text{ cm.}$, and the temperature coefficient of the electrical resistance: $10^5 \alpha = 364$. Niobium prepared by thermal dissociation of the pentachloride has a lattice with $a = 3.294 \pm 0.001$ Å.—M. H.

***Specific Heat of Thallium at Liquid Helium Temperatures.** W. H. Keesom and J. A. Kok (*Physica*, 1934, 1, 175–181; *Brit. Chem. Abs.*, 1934, [A], 246).—Measurements have been made from 1.3° to 4.2° abs. The atomic heat falls from 0.01325 to 0.01177 at the transition point. No latent heat was observed at this point.—S. G.

New Determination of the Half-Period Life of Thorium. Hans Fesefeldt (*Z. Physik*, 1933, 86, 605–610).—The total number of α -particles emitted per second from 1 grm. of thorium is found to be 4.7×10^3 . This result agrees with that obtained by Geiger and Rutherford. The corresponding half-period life of thorium is 1.3×10^{10} years.—J. S. G. T.

***The Adsorption of Hydrogen on Tungsten.** J. K. Roberts (*Proc. Camb. Phil. Soc.*, 1934, 30, 74–79).—Saturation occurs when the partial pressure of hydrogen is less than 4×10^{-4} mm.—E. S. H.

On the Cause of the "Hardness" of Electrolytic Zinc. A. A. Botchvar and A. J. Uljanow (*Zvetnye Metally (The Non-Ferrous Metals)*, 1932, 7, 33–36; *Chem. Zentr.*, 1934, 105, I, 2343).—The hardness of zinc does not primarily depend on the thermal treatment, since the presence of iron has a profound effect on the recrystallization process, as little as 0.2% preventing it entirely. The hardness is unaffected by 0.2% lead, but 0.1–0.2% cadmium increases it appreciably. In making zinc sheets of uniform hardness strict control of the iron content is essential.—A. R. P.

***The Effect on the Density of Zinc of Deformation by Cold- and Hot-Rolling.** O. Bauer and P. Zunker (*Mitt. Material., Sonderheft* 24, 1934, 93–98).—See *J. Inst. Metals*, 1933, 53, 612–613.—J. W.

Composition of Zinc for Polygraphic Zinc Type Plates. M. D. Zudin (*Zvetnye Metally (The Non-Ferrous Metals)*, 1933, (1), 100–103; *C. Abs.*, 1934, 28, 1966).—[In Russian.] Compositions of Russian and imported zinc for type plates are given. Hardness and fine grain are obtained by adding small amounts of cadmium (up to 0.5%). Melting in an induction furnace is recommended.—S. G.

***Superconductivity of Zinc.** W. H. Keesom (*Physica*, 1933, 1, 123–127; *Brit. Chem. Abs.*, 1934, [A], 135).—Zinc becomes superconducting at 0.79° abs. Cadmium and gold are not superconducting at 0.73° abs., or platinum at 0.77° abs. Phosphor-bronze is not superconducting at 0.75° abs., so copper is probably not superconductive at that temperature.—S. G.

***The Question of the [Possible] Radioactivity of Zinc.** Hans Fesefeldt (*Z. Physik*, 1933, 86, 611–614).—F. finds that the α -radiation observed from pure zinc is of the order of $\frac{1}{10}$ th of that obtained by Ziegert, using zinc residues.

—J. S. G. T.

Production of Single Crystals with Prescribed Axial Orientation. P. A. Palibin and A. I. Froiman (*Z. Krist.*, 1933, 85, 322–325; *Brit. Chem. Abs.*, 1933, [A], 665).—A method for obtaining crystals of, for example, zinc or cadmium with the hexagonal axis parallel to their length is described.—S. G.

***The Condition Determining Flow of Crystals.** W. Boas and E. Schmid (*Z. Physik*, 1933, 86, 828–830).—The question whether incidence of flow in strained crystals is conditioned by the attainment of a constant shear stress (*Schubspannung*) or a constant elastic slip (*Schiebung*) in the translation system is answered in favour of the former hypothesis.—J. S. G. T.

The Effect of Cold-Work on Metals. Gustav Tammann (*Forschungen u. Fortschritte*, 1934, 10, 128–129).—A summary of T.'s work on the cold-working and recovery of metals from a theoretical point of view.—J. W.

***The Influence of Prior Stress on Fatigue Strength.** P. Ludwik and J. Krystof (*Anz. Akad. Wiss. Wien*, 1933, 70, 51-52).—Using steel, high-grade cast iron, and non-ferrous test-pieces, the relations between initial stress, alternating stress, and fatigue above and before the plastic limit have been determined. For stresses below the torsion and tensile limits, the fatigue strength in torsion was $\tau_0 = \tau_w + x_t \tau$, and in bending $\sigma_0 = \sigma_w + x_b \sigma$, where τ_w and σ_w are respectively the strength under alternating loads in torsion and bending, and x_t and x_b are respectively coefficients independent of the magnitude of the prior stress. The effect of corroding influences has been studied.

—W. A. C. N.

Nature of "Yield-Value." G. W. S. Blair (*Physics*, 1933, 4, 113-118; *Sci. Abs.*, 1933, [B], 36, 327).—The flow of materials at stresses far below their normal yield-values is discussed, and B. points out that the sharpness with which yield-values can be measured depends on the grouping of the relaxation times for the different strains set up within the material, an uneven distribution making for a sharper definition. Any sharp and drastic change in the relaxation time of the system as a whole may justifiably be said to constitute a yield-value, the question as to which of these points is actually taken as the yield-value depending on the conditions of the experiment. The results (to date) are discussed of certain experiments on flour doughs, which it is claimed are peculiarly suitable material for such investigations. A new rapid method, recently described, for studying flow in flour doughs is discussed. The dangers of classifying materials in hard-and-fast rheological divisions is emphasized; for practical purposes, however, and given adequate safeguards, such classifications may be extremely useful.—S. G.

***Studies on the Transformation of Metals by Secondary Electron Emission.** Kazuma Hayakawa (*Sci. Rep. Tôhoku Imp. Univ.*, 1934, [i], 22, 934-958).—[In English.] Methods have been devised for studying phase transformations in metals by (a) measuring the secondary electron emission excited by the thermionic current at various temperatures and (b) measuring the ionisation current at various temperatures. Changes have been observed in the range of magnetic transformation in the case of nickel, cobalt, and iron-nickel alloys.—E. S. H.

***Investigations Relating to Metallic Films.** H. Zahn and J. Kramer (*Z. Physik*, 1933, 86, 413-420).—Electrolytically deposited antimony and platinum are shown to be transformed into the crystalline state by being heated above a definite transformation temperature—222° C. in the case of platinum, 160° C. in the case of antimony—which is characteristic of the metal irrespective of its mode of production. Very thin metal films are shown to be necessarily amorphous to some extent.—J. S. G. T.

***The Optical Properties of Metals.** N. F. Mott (*Proc. Camb. Phil. Soc.*, 1934, 30, 249-270).—A discussion on theoretical lines.—E. S. H.

Electrical Properties of Metals and Wave Mechanics. L. Brillouin (*Rev. gen. Élect.*, 1933, 34, 163-175, 202-208; *Sci. Abs.*, 1933, [B], 36, 615).—A non-technical account is given of the modern theory of the conduction of electricity in metals, based on the conception that electrons are physically "waves" which are transmitted through the crystal lattice formed by the metal. Hartree's theory of "self-consistent" field for dealing with this problem is explained, as well as the use which is made of the Fermi-Dirac statistics. The subjects of thermoelectric emission of electrons from hot metals, of thermal agitation, of magnetism, and of superconductivity are dealt with in detail.

—S. G.

***On the Theory of Liquid Metals.** S. Shubin (*Zhurnal eksperimentalnoy i teoreticheskoy Fiziki (Journal of Experimental and Theoretical Physics)*, 1933, 3, (6), 461-474).—[In Russian.] A number of points in connection with the theory of conduction electrons in liquid metals are examined. In particular, the question of the movement of electrons in the field of an almost uniform,

non-periodic potential is considered in detail: it is shown that these electrons possess all the properties characteristic of the "almost free" electron. The behaviour of such an electron in constant and alternating fields was investigated. The relation between the conductance electrons and the thermal motion of ions was examined: if thermal motion of liquid ions be regarded as small oscillations round the point of stable equilibrium, then (in spite of the irregularity of the distribution of the centres of oscillation) we would have had the usual relation of the form $R = AT$ for the specific resistance at high temperatures. The resistance of liquid metals includes the rest part independent of temperature, which is explained by the large number of isoelectric conditions of the liquid which render impossible the processes of direct distribution of the electrons among the ions.—N. A.

Change in the Electrical Conductivity of a Metal Foil Dependent on Its Electric Charge. G. Polvani (*Nuovo cimento*, 1932, 9, 69–71).—S. G.

Some Measurements of Contact Resistances at Low Temperatures. R. Holm and W. Meissner (*Z. Physik*, 1933, 86, 787–791).—Measurements of the contact-resistances between gold–gold, copper–copper, and nickel–nickel surfaces at room temperature and at 20° abs. indicate the presence at the contact of a transition layer having an electrical resistance of the order 10^{-9} ohm/cm.² of contact surface in the cases of gold and copper, and 50×10^{-9} ohm/cm.² in the case of nickel, these values being practically independent of the temperature. These transition resistances obey Ohm's law over a considerable range of e.m.f.—J. S. G. T.

A New Effect at the Commencement of Superconductivity. W. Meissner and R. Ochsenfeld (*Naturwiss.*, 1933, 21, 787–788).—When a cylindrical lead or tin rod is brought into a homogeneous magnetic field perpendicular to its axis, the changes in distribution of the lines of force in the neighbourhood of the rod, on cooling below the spring point, follow those which would occur in the permeability σ and the diamagnetic susceptibility $-1/4\pi$. In the inside of a long lead tube, in spite of this effect around the tube, the magnetic field remains practically unchanged when the spring point is passed. These results can probably be represented by the development of micro- or macroscopic currents in the superconductor on the assumption of a permeability of 1 in the current-free parts. These currents change or develop spontaneously when the metal becomes a superconductor.—J. W.

***Magnetic Permeability of Ferromagnetic Metals at Very High Frequencies.** G. Potapenko and R. Sanger (*Naturwiss.*, 1933, 21, 818–819).—The permeability of iron, nickel, and cobalt decreases rapidly with increasing frequency, probably owing to some relationship between the surface layer of ferromagnetic conductors and a magnetic secondary structure.—J. W.

Magnetism of the Metals. E. Vogt (*Ergebn. exakt. Naturwiss.*, 1932, 11, 323–351; *Brit. Chem. Abs.*, 1933, [A], 342).—A discussion of the magnetic properties of metals in relation to the quantum states of the atoms in the crystal lattice.—S. G.

***The Change of Magnetic Susceptibility in Metals and Alloys Caused by Internal Stress.** Yosomatsu Shimizu (*Sci. Rep. Tôhoku Imp. Univ.*, 1933, [1], 22, 915–933 [in English]; and *Kinzoku no Kenkyu*, 1934, 11, 159–174 [in Japanese]).—Cf. *Met. Abs.*, this volume, p. 3. The paramagnetic susceptibility of metals and alloys decreases, whilst the diamagnetic susceptibility increases numerically with increasing degree of residual internal stress. The susceptibility of a homogeneous platinum–gold alloy, containing 30 atomic-% of platinum, is changed from paramagnetic to diamagnetic by cold-working. A theory is proposed in explanation of these results.—E. S. H.

***Electron Interference at Mechanically-Worked Surfaces.** H. Raether (*Z. Physik*, 1933, 86, 82–104).—The effects of scratching, rubbing emery, polishing,

pressing, and hammering on metallic and non-metallic surfaces are investigated in considerable detail by means of electron interference.—J. S. G. T.

The Positive Electron. Paul Langevin (*Bull. Soc. franç. Élect.*, 1934, [v], 4, 335).—The experimental and theoretical considerations underlying modern conceptions of atomic structure are reviewed. L. emphasizes that in certain important instances, notably on the questions of magnetic spin, and of the existence of the positive electron, experimental verification has followed deductions made by Dirac and others on purely theoretical grounds. Certain problems of transmutation are considered in the light of recent work by Irène Curie and Joliot on the bombardment of aluminium, magnesium, and boron by α -rays, and some phenomena are predicted which await verification.

—P. M. C. R.

***A Note on the Theory of the Photoelectric Current Across a Metal Semiconductor Contact.** R. H. Fowler (*Proc. Camb. Phil. Soc.*, 1934, 30, 55–58).—Theoretical.—E. S. H.

Report of the Physikalisch-Technische Reichsanstalt for 1933. Anon. (*Physikal. Z.*, 1934, 35, 217–248).—The annual report is briefly reviewed. Amongst matters which receive notice are the following: resistance and super-conduction of various metals and alloys; chemical and physical properties of rhenium; purification of masurium; preparation of extremely pure samples of aluminium, iron, zinc, niobium, tantalum, platinum, iridium, and gold; change of length of Invar wires due to flaws; elastic constants of aluminium and magnesium single crystals; heats of transformation of cobalt and iron; magnetic transformations exhibited by nickel and alloys of this metal with copper, chromium, silicon, tungsten, aluminium, cobalt, iron, and of iron with chromium; use of iron–chromium alloys for the construction of resistances; magnetostriction; effect of composition and heat-treatment on the hysteresis of ferromagnetic metals and alloys; resistance thermometers of lead and gold; capillary constants of gold; adiabatic metallic calorimeter for high temperatures; thermal conductivity of metals.—J. S. G. T.

II.—PROPERTIES OF ALLOYS

(Continued from pp. 231–237.)

***Equilibrium Diagram of the System Aluminium–Copper–Manganese.** Hachie Sawamoto (*Suiyokwai-shi*, 1933, 8, 239–244; *C. Abs.*, 1933, 28, 2254).—[In Japanese.] The constitution of the aluminium-rich aluminium–copper–manganese alloys containing up to 40% copper and 30% manganese was investigated by means of differential thermal analysis and microscopic examination. A peritectic–eutectic reaction $\text{liquid} + \text{Al}_3\text{Mn} \rightleftharpoons \text{Al}_3\text{Mn} + (\text{Al})$ occurred at 630°C . and at the composition copper 8.3, manganese 1.75, and aluminium 89.95%, and a ternary eutectic reaction $\text{liquid} \rightleftharpoons \text{CuAl}_2 + \text{Al}_3\text{Mn} + (\text{Al})$ took place at 544°C ., the composition being copper 30.5, manganese 0.65, and aluminium 68.85%.—S. G.

***Investigations of the Transformations in the Solid State in Magnesium–Silicon–Aluminium Alloys.** A. A. Botchvar, K. W. Gorew, and A. M. Korolkow (*Metallurg (The Metallurgist)*, 1932, 8, (1), 7–20; *Chem. Zentr.*, 1934, 105, I, 1931).—[In Russian.] The equilibria in the ternary system up to 2% silicon and 3% magnesium have been determined. The solid solubility of silicon and Mg_2Si in aluminium is decreased by excess of either constituent, contrary to the statement of Hanson and Gayler (*J. Inst. Metals*, 1921, 26, 321–359) that excess of silicon increases the solid solubility of Mg_2Si . B., G., and K. also find that excess of magnesium has a greater depressing effect on the solid solubility of Mg_2Si in aluminium than stated by H. and G. From the changes in hardness on heat-treatment of Aldrey with 0.2–0.4% iron it is shown that an excess of silicon increases the effect of heat-treatment, but has no effect in iron-free

Aldrey, except to retard somewhat the ageing; this difference is attributed to the formation of FeSi, so that an excess of silicon is necessary to get the full effect due to Mg_2Si .—A. R. P.

***The Transformations in Solid Alloys of Aluminium with up to 30% Zinc and 12% Magnesium.** A. A. Botchvar and M. O. Kuznetsov (*Metallurg (The Metallurgist)*, 1933, 8, (2), 7-14; *Chem. Zentr.*, 1934, 105, I, 2345).—[In Russian.] The solubility isotherms of the ternary system magnesium-zinc-aluminium have been determined at 200°, 400°, and 450° C. by micro-analysis of specimens quenched in water after prolonged annealing. The solubility of $MgZn_2$ is a maximum of 16-17%, whereas Sander and Meissner found 25%. The phases in equilibrium with the ternary γ -solid solution could not be ascertained by the method employed.—A. R. P.

***The Influence of Heat-Treatment with Age-Hardening and Prolonged Storage on the Properties of an Aluminium Alloy.** W. Schwinning and E. Dorgerloh (*Z. Metallkunde*, 1934, 26, 91-92).—The influence of the quenching temperature (460°, 490°, 530° C.) and ageing temperature (8 hrs. at 120°, 145°, 160°, 175° C.) on the tensile properties, endurance, vibration strength (rotating bending), and electrical conductivity of 3 mm. conductor wires of an aluminium alloy containing magnesium (composition not stated) has been investigated. Results are shown in tables and graphs. Quenching at 490° \pm 10° C. proved to be best; with a lower quenching temperature the yield-point, tensile strength, and endurance strength decrease and the conductivity only slightly increases. Quenching at 530° \pm 10° C. has practically no advantage in any respect. To obtain good mechanical properties the lowest ageing temperature should be selected consonant with the production of the desired electrical conductivity. In wires quenched at 490° C., tempered at 160° C. for 8 hrs. and stored at room-temperature the endurance strength increases from 10 to 11.5 kg./mm.², during 7 months, while the tensile properties remain unchanged, but after 2 years, the endurance strength decreases again to 10 kg./mm.², while the yield-point and tensile strength slightly decrease and the elongation and reduction of area slightly increase.—M. H.

Progress in Light Metal Castings for High Stresses. G. Sachs (*Z. V. d. I.*, 1933, 77, 115-120; *Sci. Abs.*, 1933, [B], 36, 327).—Cf. *J. Inst. Metals*, 1933, 53, 294. A description of some improved alloys of the surface-hardened aluminium-silicon type which are likely to be of use in petrol and Diesel engines. Addition of copper to aluminium-silicon alloys increases the fatigue strength, while addition of magnesium coupled with suitable heat-treatment improves the mechanical properties generally.—S. G.

The Aluminium-Silicon Alloys. Maurice Dérivé (*Technique Automobile et Aérienne*, 1934, 25, (164), 7-13).—A review of the constitution, microstructure, preparation, uses, and properties of these alloys. The mechanical properties of the 5% sand- and chill-cast alloy are tabulated. Apart from certain high-silicon alloys (18-20% silicon), Alpac is far the most important binary alloy, and its mechanical and physical properties are fully considered. Ternary and other derivatives of Alpac include Birmasil (nickel 2-3.5%), and Lo-Ex (silicon 13-14, nickel 2, copper 1, magnesium 1%). Commercial alloys of higher silicon content include the KS series, Supra-Kolben, Alusil, Supra-Alu S.S., and Alsia; properties and analyses are given in most cases. Duralumin is fully described, with a table of mechanical properties corresponding with 7 commercial treatments: other alloys especially noticed, with details of analysis and mechanical properties, are Almasilium (Anticorodal), the L.M. series, the "R.R." (Hiduminium) alloys, the KS anti-corrosion alloys, a copper-silicon die-casting alloy, Almelec, and Aldrey. Analyses only are given for Feralsit, Silical, silico-mangano-aluminium, Mansical, Alsimin. A bibliography is given.—P. M. C. R.

*The Influence of Alternating Stresses on the Tensile Properties and Damping Power of Aluminium Alloys. H. Frankenberg (*Light Metals Research*, 1934, 2, (47), 1-11).—Translated from *Metallwirtschaft*, 1934, 13, 187-191. See *Met. Abs.*, this volume, p. 231.—J. C. C.

*The Influence of Addition Metals on the Electric Conductivity of Aluminium. H. Bohner (*Light Metals Research*, 1934, 2, (47), 12-17).—Translated from *Z. Metallkunde*, 1934, 26, 45-47; see *Met. Abs.*, this volume, p. 168.—J. C. C.

Beryllium Alloys from the Electrical Point of View. A. Donat (*Machine moderne*, 1934, 28, 104).—Cf. *ibid.*, 1933, 27, 294, 574-575. Beryllium, when used as a deoxidant in the casting of copper and of certain of its alloys, greatly increases the electrical conductivity of the product. Conductivities for samples of sand-cast copper deoxidized with (a) 0.02% phosphorus, (b) 0.01% beryllium, and (c) 0.02-0.03% beryllium, are given, together with corresponding values for several ordinary copper alloys. The conductivities of 8 copper-beryllium alloys are tabulated for hard and soft conditions.—P. M. C. R.

*The Eutectoidal Decomposition of Solid Solutions of β -Copper-Aluminium Alloys. N. W. Ageew and G. W. Kurdjumow (*Metallurg (The Metallurgist)*, 1932, 7, (9), 3-21; *Chem. Zentr.*, 1934, 105, I, 2344).—[In Russian.] Cf. *J. Inst. Metals*, 1933, 53, 237. X-ray and micrographic examination, and determinations of the hardness and coeff. of expansion show that the β -phase in copper-aluminium alloys decomposes on cooling into a eutectoidal mixture of ($\alpha + \gamma$), both of which have face-centred cubic lattices, the γ lattice containing 52 atoms in the unit cell. No intermediate phase is formed during slow cooling through 540° C., all the properties conforming to a mixture of the α - and γ -phases. A stable intermediate stage is obtained only on very rapid cooling.

—A. R. P.

*Researches on Copper Alloys Containing Cadmium. P. I. Gradusov (*Metallurg (The Metallurgist)*, 1932, 7, (9), 79-83; *Chem. Zentr.*, 1934, 105, I, 2033).—[In Russian.] The value of copper alloys with 0.5-2% cadmium for deoxidizing copper has been investigated. Under the same conditions as used when phosphor-copper is employed as deoxidant, the loss of cadmium does not exceed 2% of that added. The addition of small quantities of cadmium to copper increases the tensile strength, but reduces the conductivity; for hot-rolling the copper should be heated to 780°-800° C. With increasing cadmium content the intensity of recrystallization of hard-drawn copper is increased; 600° C. is the best annealing temperature for cadmium-copper, and 0.8% cadmium gives the best combination of mechanical and electrical properties.

—A. R. P.

Investigations of the Phenomena of Diffusion of Copper in Iron with Reference to the Manufacture of Bimetals. M. I. Sacharowa (*Zvetnye Metally (The Non-Ferrous Metals)*, 1932, 7, 542-550; *Chem. Zentr.*, 1934, 105, I, 2342).—[In Russian.] The rate of diffusion of copper into iron is very small, and appears to proceed along the crystal boundaries, especially in the case of soft iron containing silicon and manganese. At a magnification of 1000 a surface zone consisting of a solid solution of iron in copper can be observed on the copper.

—A. R. P.

Copper-Lead Anti-Friction Alloys. M. P. Slavinski, A. E. Vol, I. V. Gutman, G. T. Fomin, and L. R. Edelson (*Metallurg (The Metallurgist)*, 1933, 8, (4/5), 91-109; (6), 3-21; *C. Abs.*, 1934, 28, 1644).—[In Russian.] Copper-lead alloys with small additions of nickel, tin, zinc, and phosphorus are homogeneous above the melting point, but separate into 2 layers below the melting point of copper with pure copper freezing out separately. With larger additions, layers of copper containing lead and of lead containing copper are formed. If considerable amounts of nickel are present, lead is evenly distributed in the solid state. Additions of 1-15% of nickel and 1-18% of zinc to a 10% tin-bronze containing 10, 20, and 30% lead show that nickel raises the

melting point and causes equal distribution and fineness of the lead particles and decreases the δ -constituent. Up to 10% of nickel increases the hardness but larger amounts decrease the hardness. Zinc causes unequal distribution, decreases hardness and increases plasticity. Phosphorus also causes unequal distribution of the lead. A list is given of 18 copper-tin-lead-nickel-zinc alloys which are probably suitable for bearings.—S. G.

Selenium [Copper] Compound of High Thermoelectric Power. M. A. Levitiskaja and V. J. Dlugac (*Dokladii Akademii Nauk U.S.S.R. (Compt. rend. Acad. Sci. U.R.S.S.)*, 1933, 106–108 (in Russian), 109–110 (in German); *Brit. Chem. Abs.*, 1934, [A], 19).—The properties of Cu_2Se are described.—S. G.

Nida Bronze. Anon. (*Metallwirtschaft*, 1934, 13, (10), 175–176; and *Automobiltech. Z.*, 1934, 37, (4), 115–117).—Nida bronze is a phosphor-bronze with 8–9% tin which has been hot-worked then cold-worked to the finishing state; it is particularly suitable for bearings capable of withstanding high loads at high speed. The tensile strength is 40 kg./mm.² in the soft, and 80 kg./mm.² in the hard state; the corresponding elongations are 70 and 7%, and Brinell hardness 95 and 200. The corrosion-resistance and other mechanical properties are also given.—v. G.

***Chemical Investigation of an Alleged Ancient Greek Statuette.** Earle R. Caley (*Tech. Studies Field Fine Arts*, 1934, 2, 144–148; *C. Abs.*, 1934, 28, 1971).—The alleged Greek statuette had the following composition: copper 83.25, tin 7.36, zinc 4.87, lead 4.40, iron 0.15%, no other elements were present in determinable amounts. The absence of semi-metallic or non-metallic impurities such as arsenic or sulphur and the presence of appreciable amounts of zinc indicate that the bronze was not of ancient Greek origin. Further, the analysis does not agree with those of ancient statuary bronzes from other localities, but corresponds closely with that of a favourite modern composition for making delicate bronze castings.—S. G.

White Metal [Nickel-Brasses]. J. Cournot and F. Hiltbold (*Rev. Nickel*, 1934, 5, (1), 16–33).—A very complete summary of the constitution and physical and mechanical properties of various white metals and nickel-brasses. Specific features dealt with are casting conditions, heat-treatment, working, pickling, polishing, and pressure casting. Illustrated examples of white metal work are given. Of especial interest are the methods of testing particular to the work in hand, viz. the force necessary to bend a fork or spoon handle, or to bend a prong of a fork through a definite angle.—W. A. C. N.

***The Equilibrium Diagram Germanium-Copper.** Robert Schwarz and Gertrude Elstner (*Z. anorg. Chem.*, 1934, 217, 289–297).—The constitution of the system was studied by thermal analysis and microscopic examination of unannealed alloys. The liquidus curve consists of 5 branches corresponding with the crystallization of α (solid solution of germanium in copper), β , γ , Cu_3Ge , and germanium. There are three peritectic reactions (concentrations in atomic-% germanium in parentheses): α (10) + melt (18) \rightleftharpoons β (14) at 828° C., β (16.5) + melt (24.5) \rightleftharpoons γ (23) at 744° C., γ (24.5) + melt (30) \rightleftharpoons Cu_3Ge at 700° C. Cu_3Ge and germanium form a eutectic at 35 atomic-% germanium and 650° C., γ has a transformation point at 558° C., and Cu_3Ge at 615° C.—M. H.

Some Causes of Variations in Hardness of Gold-Copper Castings. Harry H. Aster and John A. Comstock (*J. Dental Research*, 1933, 13, 407–413).—In making dental castings of gold-copper alloys porosity always occurs at the sprue; the point of sprueing should therefore be made on the smaller surfaces of the castings, and on parts which are not to be subjected to strains or stresses. Hardness variations due to segregation and coring of the crystallites may be overcome by annealing at about 850° C.; precipitation-hardening effects do not occur in the simple binary alloys used in dentistry.—A. R. P.

On the Relations Between the Diffusion Coefficients and Concentration in the Gold-Platinum, Gold-Palladium, and Gold-Nickel Systems. Chujiro Matano (*Proc. Phys. Math. Soc. Japan (Nippon Sūgaku Buturi-gakkwai Kizi)*, 1933, **15**, 405-406; *Chem. Zentr.*, 1934, **105**, I, 1931).—[In English.] The diffusion coeff. in these systems have been calculated, taking into account the dependence of the coeff. on the composition, from data published by Jedele (*J. Inst. Metals*, 1933, **53**, 697). The results obtained differ from those of J. by an amount which increases with the gold content of the alloys.—A. R. P.

***Alloys of Iron Research. XI.—The Constitution of the Alloys of Iron and Manganese.** Marie L. V. Gayler. Appendix.—**X-Ray Analysis of Manganese-Rich Alloys Heat-Treated and Quenched from Different Temperatures.** C. Wainwright (*J. Iron Steel Inst.*, 1933, **128**, 293-340; discussion, 341-353).—For abstract of the paper and appendix see *J. Inst. Metals*, 1933, **53**, 624. In the discussion W. Rosenhain emphasized the important effect which small quantities of impurities could have on the equilibria in certain metallic systems. E. Ohman stated that the 66% manganese alloy annealed at 1200° C. and cooled in the furnace showed the lines only of β -manganese, $a = 6.255 \text{ \AA}$., and suggested that this surprising result is due to the slowness of the $\beta \rightarrow \alpha$ transformation in iron-manganese alloys. In quenching powdered specimens of these alloys from just above the transformation point, it is difficult to suppress the transformation, whereas suppression is easy with coarse-grained alloys. Quenching experiments with filings of alloys containing about 55% manganese showed that the two-phase γ -iron/ α -manganese region was incorrectly drawn in Gayler's diagram, and indicated that α -manganese is precipitated from the γ -phase during cooling. Cyril Wells and F. M. Walters, Jr., gave a summary of the results of their work on alloys in the range 0-30% manganese. They also had found evidence of a eutectoid at 67.7% manganese and 707° C., and that the solubility limit of manganese in γ -iron at 650° C. was about 55%, i.e. about midway between that given by Ö. and that given by G. Alloys with 74-94% manganese showed a tetragonal structure when quenched from the γ -field, but a cubic structure when more slowly cooled, and they suggested that the γ -iron and γ -manganese phases were identical. In reply, G. put forward evidence which indicated that the eutectoid found by W. and W. at 67.7% manganese was really due to the presence of nitrogen in the alloys, but agreed that much more work was necessary to clear up various points which had emerged in the discussion.—A. R. P.

***The System Manganese-Nitrogen.** Rudolf Schenck and August Kortengraber (*Z. anorg. Chem.*, 1933, **210**, 273-285).—The system up to 10% nitrogen has been studied by determination of the equilibrium isotherms (pressure-concentration) between 540° and 800° C.; these have a horizontal portion which shortens with rise in temperature and vanishes at about 800° C. The end-points of these horizontals correspond with the compositions of the two solid phases which co-exist in a nitrogen atmosphere; (a) contains 6.63% nitrogen at 540°-800° C., and (b) 8.8% at 540° C. and 6.3% at 800° C., i.e. it loses nitrogen with rise in temperature until at 800° C. it merges into the first phase. X-ray analysis has shown that (a) is Hagg's cubic face-centred ϵ -phase and (b) his close-packed hexagonal ζ -phase (cf. *J. Inst. Metals*, 1930, **43**, 530).—M. H.

***The Binary System MnO-SiO₂.** J. White, D. D. Howat, and R. Hay (*J. Roy. Tech. Coll. (Glasgow)*, 1934, **3**, 231-240).—The diagram for the system MnO-SiO₂ is developed from thermal data and the phase changes in many cases are confirmed by observations with a high-temperature microscope. A description of the apparatus for this including furnace, crucible, and thermocouple arrangements is given, and it is stated that the highest temperature attained in this apparatus was 1650° C. A differential method is employed to obtain the thermal curves, and molybdenum crucibles, made by drilling holes in molybdenum rods, are used with success for melting the various mixtures.

The preparation of the various melts and the checking of their purity by chemical and spectrographic methods are discussed. The solid phases of the system are confirmed by examination of their optical properties.—J. W. D.

***The Equilibrium Diagram Manganese-Silicon.** Rudolf Vogel and Herbert Bedarff (*Arch. Eisenhüttenwesen*, 1933-1934, 7, 423-425).—The equilibrium diagram of the system from 0 to 34% silicon (MnSi) has been redetermined by thermal and micrographic methods. The existence of Mn_2Si could not be confirmed, but two new compounds have been discovered, Mn_3Si_3 and Mn_3Si ; the latter melts incongruently, and can dissolve up to 1% manganese in the solid state. The two transformations of manganese occur at higher temperatures with increasing silicon content of the alloys.—J. W.

***High-Grade Chromium-Nickel Alloys and Life Tests Thereon.** W. Hessenbruch and W. Rohn (*Elektrowärme*, 1933, 3, 245-249, 294-297, 317-322).—See *J. Inst. Metals*, 1933, 53, 624-625, 697.—S. G.

Engineering Properties of Monel Metal. Anon. (*Henry Wiggin and Co., Ltd.*, 1934, (MB 7), 1-10).—The mechanical properties of Monel metal in various states are tabulated, the composition, physical properties, and technical data are given, and the resistance of the alloy to the corrosion of a number of different agents at various temperatures and the working properties are described.—J. H. W.

***Large Barkhausen Discontinuities and Their Propagation in Nickel-Iron Alloys.** Raymond E. Reinhart (*Phys. Rev.*, 1934, [ii], 45, 420-424).—*Cf. Met. Abs.*, this volume, p. 236. The propagation of large Barkhausen discontinuities in 10% nickel-iron alloy wire, 0.0334 cm. in diam., has been studied as a function of circular field, longitudinal field, torsion, and tension. Many results confirming those of Sixtus and Tonks (*J. Inst. Metals*, 1931, 47, 371; 1932, 50, 345) were obtained, and also new data. The velocity of propagation is determined by the component of the resultant field, impressed on the wire, in the direction of the principal strain axis of elongation; the component perpendicular to this direction has no appreciable effect on the velocity. A combination of heat-treatment and straining is described by means of which a nickel-iron alloy with 70% of nickel was obtained in a condition in which the effects could be studied over much wider ranges of field and velocity than with untreated wire.—W. H. R.

New Materials for Cores of Induction Coils. Materials with High Magnetic Stability; "Isoperm." O. Dahl, J. Pfaffenberger, and H. Sprung (*Elekt. Nachr. Tech.*, 1933, 10, 317-332; *Sci. Abs.*, 1933, [B], 36, 650).—In telegraphic work and technology the importance of the core of the coils used is well known. The present work has as its object the production of a working material for the manufacture of coil and armature cores the internal granular structure of which will render it particularly suitable for the purposes in view. The mechanical and thermal characteristics of such materials are first considered in relation to the magnetic behaviour required, the influence of cold formation is particularly reviewed. Whilst sufficiently small instability can be attained with many materials, yet at the same time the range is comparatively small when small hysteresis is required also. These "Isoperm" groups, namely, aluminium-nickel-iron, and in particular copper-nickel-iron alloys, are reviewed in regard to the point at issue, where it is shown that not only the mechanical, but the thermal behaviour of the material is of great importance. Comparison with other materials used illustrates the particularly valuable character of the "Isoperm" evolved by the present authors. For aluminium-nickel-iron "Isoperm" the value of μ_0 is 65 and of μ_{max} is 87, giving a ratio of 1.3, whilst for copper-nickel-iron "Isoperm" the values are 66 and 73, respectively, giving a ratio of 1:1. For tungsten steel the values are $\mu_0 = 47$ and $\mu_{max} = 188$, with a ratio of 4.0.—S. G.

Manganese-Nickel: Its Properties and Technology. P. I. Gradusov (*Metal-lurg (The Metallurgist)*, 1933, 8, (6), 46-49; *C. Abs.*, 1934, 28, 1645).—[In

Russian.] The addition of 2.5% manganese to nickel increases the tensile strength, decreases the ductility, and gives a finer microstructure. The alloy shows no noticeable grain-growth when heated to 1100° C. for 5 hrs.—S. G.

*On the Nature of the Solid Solution of Aluminium in Silver. Sadajirō Kokubo (*Sci. Rep. Tōhoku Imp. Univ.*, 1934, [i], 23, 45–51 [in English]; and *Kinzoku no Kenkyū*, 1934, 11, (3), 128–133 [in Japanese]).—The silver-aluminium alloy containing 4.5% of aluminium was studied by measuring its density. The experimental value for the density of the solid solution of aluminium in silver is somewhat lower than that calculated from X-ray data, on the basis of a simple substitution of aluminium for silver atoms in the silver lattice. It is shown that the ionized solid solution theory proposed by R. T. Phelps and W. P. Davey cannot possibly account for this discrepancy. The principal cause of the decrease in density of the alloy is attributed to minute gas holes produced during the solidification of the alloy.—S. G.

*The Freezing Points, Melting Points, and Solid Solubility Limits of the Alloys of Silver and Copper with the Elements of the B Sub-Groups. William Hume-Rothery, Gilbert W. Mabbott, and K. M. Channel Evans (*Phil. Trans. Roy. Soc.*, 1934, [A], 233, 1–97).—(1) The factors affecting the formation of primary α substitutional solid solutions in silver and copper by the elements of the B sub-groups have been investigated. Complete determinations of the solidus curves and solid solubility limits are given for the systems silver-cadmium,* silver-indium,* silver-gallium*, silver-aluminium, copper-gallium,* and copper-germanium,* liquidus determinations being made in the systems marked *. The solidus curves for the systems silver-zinc and copper-zinc, and the solubility curves for the systems copper-arsenic and copper-antimony, were also investigated. Partial or confirmatory determinations were made for the liquidus and solidus of ternary alloys of copper with zinc, gallium, and germanium, for the solidus and solubility curves of the system silver-tin, and for the solidus of the system copper-aluminium. These experimental data, and those of other investigators for further B group alloys are collected in tables showing the liquidus and solidus points for 1, 2, 3 . . . atomic-% of the different solutes, and the solubility limits at intervals of 100° C. (2) If the atomic diameters of solvent and solute differ by more than about 14% of that of the solvent, the solid solution is restricted to a few atomic-%, but where the "size factor" is favourable a solid solution may be formed, and the solubility limits generally obey clear valency laws, the solubility becoming less as the valency increases. (3) Where solvent and solute are in the same period (*e.g.*, silver, cadmium, indium . . .) alloys of a given freezing point have atomic compositions which vary inversely as the valency of the solute as far as Group V, whilst the compositions of alloys of a given melting (solidus) point are approximately inversely proportional to the square of the valency as far as Group IV. These principles permit the calculation of the solidus and liquidus points of ternary alloys. (4) Where solvent and solute are in different periods, the initial depression of freezing point is usually greater than to be expected from the normal valency effect, but in many cases the solute atoms act as though they possessed a fictitious valency which is a whole number, and to which the name "liquidus factor" is given. The same liquidus factors are shown to apply to ternary alloys, and methods are given for the calculation of liquidus points in ternary and quaternary alloys where the binary curves are known. (5) When the size factor is favourable, the maximum solid solubility is determined mainly by the concentration of valency electrons, and this principle permits the approximate calculation of solubility limits in certain ternary alloys. (6) The data are discussed theoretically, and explained on the assumption of an equilibrium involving both atoms and electrons, the electronic factor being predominant when the size factors are favourable, and the atomic factor predominant when the atomic diameters differ widely.—W. H.-R.

[Stability of] Liquid Sodium Amalgams. G. R. Paranjpe and R. M. Joshi (*J. Univ. Bombay*, 1932, 1, 17-24; *Brit. Chem. Abs.*, 1933, [A], 118).—Sodium amalgams are said to represent colloidal suspensions of sodium in mercury.

—S. G.

*The Brinell Hardness of Bearing Metals. A. Váth (*Z. Metallkunde*, 1934, 26, 83-86).—The investigation was carried out to ascertain the effect of the experimental conditions on the Brinell hardness of bearing metals with a tin or lead base. The diameter of the ball, the load, and the time of loading were varied within wide limits. The Brinell hardness of the bearing metals depends chiefly on the last two factors, the hardness being greater the shorter the time of loading, and increasing with the load to a maximum, then decreasing again. A hardness diagram has been constructed from which the hardness for different ball diameters, loads, and times of loading can be read off, so that hardness values determined under different conditions can be quickly compared.—M. H.

*On the Formation of High-Melting Metal Carbides on Heating a Carbon Filament in the Vapour of a Volatile Halogen Compound of the Metal. W. G. Burgers and J. C. M. Basart (*Z. anorg. Chem.*, 1934, 216, 209-222).—The reactions between a glowing carbon filament and the vapour of titanium chloride (in the presence of hydrogen), zirconium chloride, and tantalum chloride have been studied (a) by measuring the change in the electrical resistance of the filament, (b) by X-ray examination of the resulting products. In all cases the carbon is converted into the carbide of the metal (TiC, ZrC, or a mixture of TaC and Ta₂C, with, under certain conditions, metallic tantalum). At about 2500° C. with a regulated amount of tantalum chloride, however, the formation of Ta₂C and tantalum can be avoided. X-ray and chemical analysis shows that TiC, ZrC, and TaC can retain a certain amount of the respective metal in solid solution. The pure carbides are obtained if the reaction products are annealed either in vacuum or in an atmosphere of hydrocarbon. TiC, ZrC, and TaC have cubic face-centred lattices with $a = 4.320 \pm 0.001$ A., 4.687 ± 0.002 A., and 4.445 ± 0.001 A., respectively. The lattice of Ta₂C is hexagonal close-packed with $a = 3.091 \pm 0.001$ A., $c = 4.93 \pm 0.007$ A., $c/a = 1.595$.

—M. H.

The Superconductivity of Alloys. G. Tammann (*Z. Metallkunde*, 1934, 26, 61).—The relation between superconducting temperature and the composition and structure of various binary alloys in which either one or both constituents are superconductors is discussed.—M. H.

Some Conclusions from Rules on the Concentration of Valency Electrons in Binary Intermetallic Compounds. Harald Perltz (*J. Chem. Physics*, 1933, 1, 335-336; *Brit. Chem. Abs.*, 1934, [A], 22).—The empirical rules governing the formation of intermetallic phases of the types of β -, γ -, and ϵ -brass are expressed algebraically. These phases are not to be expected when the metals have the same number of valency electrons, but may be expected if the concentration of valency electrons of one component is $>$, and of the other $<$, $3/2$, $21/13$, or $7/4$ electrons per atom. Since the same conditions govern the appearance of β -, γ -, and ϵ -phases, all these may be expected when any one is found.—S. G.

*Quaternary Intermetallic Compounds. A. S. Russell (*Nature*, 1934, 133, 217).—The following quaternary intermetallic compounds have been formed by reaction of zinc with the ternary compound SnCu₂Hg₇ in mercury: Sn₂Cu₁₂Zn₄Hg₃, Sn₅Cu₁₅Zn₅Hg₉, SnCu₃ZnHg₆, SnCu₃ZnHg₉, Sn₄Cu₁₂Zn₄Hg₄₅, Sn₄Cu₁₂Zn₇Hg₂₁, and Sn₄Cu₁₂Zn₇Hg₃₃. The following compounds have been formed by the reaction of tin with ZnCu in mercury: Zn₈Cu₈SnHg₇, Zn₆Cu₈SnHg₉, Zn₄₀Cu₄₀Sn₁₂Hg₁₄, Zn₄₀Cu₄₀Sn₁₂Hg₂₁. The total number of valency electrons appears to be even more characteristic of an intermetallic compound than the ratio of electrons to atoms.—E. S. H.

*An Equilibrium Diagram for Ternary Alloys. V. Fischer (*Z. Metallkunde*, 1934, 26, 80-82).—A method is given for representing the constitution of

ternary systems on a rectangular, plane co-ordinate system. The new diagram is applied to the liquid-solid equilibria in the systems nickel-copper-manganese, silver-gold-copper, and silver-lead-tin.—M. H.

†Study of the Constitution [of Metals and Alloys] by Means of Magnetic Methods. II.—Ferromagnetic Measurements. A. Kussmann (*Z. Metallkunde*, 1934, 26, 25-33).—Cf. *Met. Abs.*, this volume, p. 197. A comprehensive review under the following headings: fundamental conceptions; relation between ferromagnetic properties and constitution; methods of measurement; examples of application (a) by determination of the saturation magnetization and Curie point (determination of phase limits in equilibrium diagrams, detection of the quantity of structural constituents, detection of transformations), (b) by measurement of the hysteresis properties (analysis of internal stresses produced by deformation, detection of precipitations and transformations, and study of age-hardening phenomena); 60 references are appended.—M. H.

III.—STRUCTURE

(Metallography; Macrography; Crystal Structure.)

(Continued from pp. 237-240.)

Distinction Between Doublé and Plated Gold. E. Raub (*Metallwaren-Ind. u. Galvano-Tech.*, 1934, 32, 115-118).—Reprinted from *Mitt. Forschungsinst. Edelmetalle*, 1932, 6, 57-63. See *J. Inst. Metals*, 1933, 53, 188.—A. R. P.

***Metallographic Investigation of Tungsten Wire with Addition of Thoria.** N. M. Zarubin and A. N. Koptzik (*Zvetnye Metally (The Non-Ferrous Metals)*, 1932, (5/6), 59-66; *C. Abs.*, 1934, 28, 2308).—[In Russian.] A discussion of the microstructure of tungsten wire with addition of ThO_2 , SiO_2 , and K_2O . More pores were observed in wires prepared from cheaper grades of tungsten contaminated with aluminium, molybdenum, iron, &c. The number of pores was found to be greater the finer the grain.—S. G.

Some Statistical Properties of an Annealed Alpha-Grain Aggregate.—I. R. G. Johnston and W. G. Askew (*Met. Ind. (Lond.)*, 1934, 44, 363-365).—The orientation of grains with respect to an arbitrary line drawn across a photomicrograph of a field of annealed α -crystals has been measured by taking in every grain in the field and plotting in such a way that the lengths of radii in given directions represent the number of grains found to be orientated in those directions. This method was also applied to the measurement of the directions of maximum diameters and of twins. The degree of "directionality" is expressed by the eccentricity of the ellipse which will best cover the ends of the radii. It is claimed that it has been conclusively established that quite strong "directionality" persists in the visible structure of α -brass and similar alloys, even after strong over-annealing. It is also stated that the preferred directions generally lie across the direction of last rolling, but never along it.—J. H. W.

***Petrographic Methods in Slag Examination.** R. Graham and R. Hay (*J. Roy. Tech. Coll. (Glasgow)*, 1934, 3, 241-243).—Petrographic methods for the examination of slags are discussed, and it is shown that examination of thin sections by transmitted light is very difficult, due to the friable nature of the material, and examination by reflected light is also unsatisfactory as changes in the composition of phases cannot be detected with sufficient accuracy. Utilization of the optical properties of the various phases offers a method of successful identification, and such properties as refractive index, pleochroism, isotropic or anisotropic state, and angle of extinction if anisotropic can be determined by various methods described. It is stated that the methods used have been very helpful in the elucidation of the constitution of the MnO-SiO_2 system, and have been applied with equal success to the systems FeO-MnO and FeO-MnO-SiO_2 . A table of results for the system MnO-SiO_2 is given.

—J. W. D.

Photomicrographic Investigations in the Resolving Power of Microscopic Objectives with the Violet Mercury Monochromat (Wratten Filter No. 50). A. P. H. Trivelli (*J. Amer. Microscop. Soc.*, 1930, **49**, 258–263).—The Wratten Filter No. 50 with the mercury vapour lamp gives higher resolving power than any other filter for the visible spectrum, but only if apochromatic objectives and compensating oculars are used. Filters for the visible spectrum give better results with apochromats than with achromats, and the mercury lamp with monochromatic filters gives somewhat higher resolving power with achromats than a ribbon filament lamp with the same filters.—P. M. C. R.

***X-Ray Examination of Electrolytic Chromium.** G. R. Levi and M. Tabet (*Atti R. Accad. Lincei (Roma)*, 1933, [vi], **17**, 647–653; *Brit. Chem. Abs.*, 1933, [A], 1003).—From X-ray measurements data are obtained regarding the size of particles in chromium deposits prepared by the electrolysis of solutions of $\text{Cr}_2(\text{SO}_4)_3$, CrO_3 , and NH_4 chromioxalate, respectively, and also of chromium obtained by thermal reduction.—S. G.

***The Crystal Structure of the Heusler Alloys.** A. J. Bradley and J. W. Rodgers (*Proc. Roy. Soc.*, 1934, [A], **144**, 340–359).—In an investigation of the ferromagnetic alloys of copper, manganese, and aluminium an alloy was found which showed an almost complete change of crystal structure due to heat-treatment. Drillings of this alloy, annealed for several hrs. at 500°C . and cooled slowly to room temperature, were found to have the δ copper–aluminium (Cu_6Al_4) type of structure. The formula of the alloy can be written $(\text{CuMn})_6\text{Al}_4$. The annealed and slowly cooled alloy is non-magnetic, but on quenching from 800°C . it becomes strongly ferromagnetic. The structure is now entirely body-centred cubic, with a face-centred superlattice. A method of X-ray analysis capable of distinguishing manganese atoms from copper atoms depending on the comparison of X-ray powder photographs of the alloy using radiations from iron, copper, and zinc anticathodes was developed and the results indicated that the actual structure differed slightly from the ideal structure of the ferromagnetic alloy. In the actual specimen examined there was a deficit of manganese atoms. The alloy was nevertheless homogeneous, some copper taking the place of the missing manganese atoms. The aluminium atoms in excess were distributed equally in the positions normally occupied by copper and manganese.—J. S. G. T.

***Crystal Structure of the Compound LaAl_4 .** A. Rossi (*Atti R. Accad. Lincei (Roma)*, 1933, [vi], **17**, 182–185; *Brit. Chem. Abs.*, 1933, [A], 558).—Cleavage takes place along the (001) pinacoid faces, and the lattice distance between the cleavage planes is 5.1 Å. or an integral multiple thereof. The unit cell has $a = 13.2$ Å., $c/a = 0.77$; $d_{\text{calc.}} = 3.69$, $d_{\text{obs.}} = 3.86$.—S. G.

***Crystal Structure of LaSn_3 and LaPb_3 .** A. Rossi (*Atti R. Accad. Lincei (Roma)*, 1933, [vi], **17**, 839–846; *Brit. Chem. Abs.*, 1933, [A], 1003).—The following data are obtained by the powder method: LaSn_3 , $a = 4.77$ Å., $d = 7.15$ – 7.20 , $d_{\text{calc.}} = 7.516$; LaPb_3 , $a = 4.893$, $d = 10.50$, $d_{\text{calc.}} = 10.71$.—S. G.

***X-Ray Investigation of the Compounds MgZn and MgZn_5 .** L. Tarschisch (*Z. Krist.*, 1933, **86**, 423–438; *C. Abs.*, 1933, **28**, 2238).—The existence of MgZn is proved by X-ray data. The structure resembles that of MgZn_2 . The latter has a hexagonal unit containing 4 mols. (4 Mg + 8 Zn). A similar unit for MgZn , with $a = 5.33$ and $c = 8.58$ Å. contains 6 mols. (6 Mg and 6 Zn), but certain weak reflections indicate that the true unit cell should be doubled. For MgZn_5 $a = 9.92$, $c = 16.48$ Å., with 16 mols.; D_6^6 , calculated density = 6.60. Both structures consist of alternate layers of magnesium and zinc atoms.—S. G.

The [Crystal] Structure and Gas Content of Nickel Films, Produced by Cathodic Sputtering. Wilhelm Büsser and Friedrich Gross (*Z. Physik*, 1933, **86**, 135–136).—Nickel films produced by cathodic sputtering in hydrogen or in neon + helium are either hexagonal I or cubic (A) in structure; produced in nitrogen, the films are tetragonal, hexagonal II, or cubic (B). The phases of

(A) are transformable one into the other; the same holds for the phases (B). Films (A) contain hydrogen, whilst films (B) contain nitrogen and hydrogen. The ratio between the amount of dissolved gas and the amount of metal is briefly discussed.—J. S. G. T.

***The Crystalline Structure of PrMg.** A. Rossi and A. Iandelli (*Atti R. Accad. Lincei (Roma)*, 1933, [vi], 18, 156-161; *C. Abs.*, 1933, 28, 2238).—The structure of PrMg was determined by the powder method. On the basis of the structure determined, the density is calculated as 4.65 (4.67 determined). The structure should be cubic with 2 atoms each of magnesium and praseodymium at the diagonally opposite corners. The side a would then be 10.8 Å., whereas the value found for $n = 2$ is 7.77 Å.; hence this supposed structure cannot be correct.—S. G.

***X-Ray Study of the Binary Alloys of Silicon with Silver, Gold, Lead, Tin, Zinc, Cadmium, Antimony, and Bismuth.** Eric R. Jette and Emery B. Gebert (*J. Chem. Physics*, 1933, 1, 753-755).—The lattice constants of these alloys have been measured. It is shown that the lattice constants of the elements in these alloys are practically identical with those of the pure elements. This fact leads to the interpretation that mutual solubility of the elements in these alloys occurs to only a very slight extent. It is further observed that silicon forms no compounds with any of these elements.—S. G.

Surface [Crystal] Lattice Interference Exhibited by Electron Radiation Incident on Thin Silver Films. H. Lassen (*Physikal. Z.*, 1934, 35, 172-175).—Silver films, deposited on rock salt in high vacuum, are found frequently to possess a single-crystal structure, the face of the cubic crystal structure lying parallel to the plane of the film.—J. S. G. T.

***Crystal Structure of Phase A of the System Ag-Li.** H. Perltz (*Z. Krist.*, 1933, 86, 155-158; *Brit. Chem. Abs.*, 1933, [A], 1007).—Phase A, with 76.3-80.2 atomic-% lithium, has a cubic unit cell containing 52 atoms, with $a = 9.94$ Å.—S. G.

***The Structure of Silver Amalgam.** A. Weryha (*Z. Krist.*, 1933, 86, 335-339; *C. Abs.*, 1934, 28, 2238).—By adding drops of mercury to a dilute solution of AgNO_3 , prismatic crystals of Ag_3Hg_4 [Note: In accordance with the Hume-Rothery rule, this γ -phase would be expected to have the formula Ag_6Hg_8 , and this was found by Preston] were obtained. These were six-sided and proved to be cubic. Powder photographs of these crystals, and also of silver wire dipped in mercury, indicate a unit cube with $a = 1.09$ Å., containing 4 mols., space group O_h^2 . Atomic positions are suggested.—S. G.

***X-Ray Proof of [the Existence of] ZrW_2 .** A. Claasen and W. G. Burgers (*Z. Krist.*, 1933, 86, 100-105; *Brit. Chem. Abs.*, 1933, [A], 1003).—X-ray examination of a tungsten wire on which, when incandescent, zirconium had been deposited from its vapour showed the presence of a face-centred cubic compound, ZrW_2 , with $a = 7.61$ Å., 8 molecules in the unit cell, $\text{Zr}-\text{W} = 3.15$ Å., $d_{\text{calc.}} = 13.78$. The structure resembles that of MgCu_2 . ZrW_2 was prepared by volatilizing zirconium on to tungsten and heating for 20 hrs. at 1800°C .; it contained a slight excess of zirconium, and had a density of 12-13.5, and melting point $> 2200^\circ\text{C}$.—S. G.

***The Electrolytic Growth of Metal Crystals.** T. Erdey-Gráz (*Naturwiss.*, 1933, 21, 799-800).—A short preliminary note on the development of growth planes on the surface of spherical silver crystals immersed in solutions of complex salts.—J. W.

†**The Effect of X-Ray Investigations on the Development of Metallography.** Ulrich Dehlinger (*Arch. Eisenhüttenwesen*, 1933-1934, 2, 523-526).—A review of the scope and most important results of the X-ray investigation of the structure of metals and alloys.—J. W.

Binding Energies in the Growth of Crystal Nuclei from Metallic Atoms. Hugh S. Taylor, Henry Eyring, and Albert Sherman (*J. Chem. Physics*, 1933, 1, 68-76;

Brit. Chem. Abs., 1933, [A], 213).—Binding energies for various geometrical configurations of 3–8 atoms of sodium, 4–5 atoms of copper, and 4 and 6 atoms of hydrogen have been calculated. The data obtained indicate the manner in which a unit cell would grow from the vapour phase in the absence of surfaces. The unit cell is shown to be unstable.—S. G.

***Characteristic X-Rays from Metals in the Extreme Ultra-Violet [Electron Theory of Metals].** H. M. O'Bryan and H. W. B. Skinner (*Phys. Rev.*, 1934, [ii], 45, 370–378).—Soft X-ray bands in the region 50–500 Å. from lithium, beryllium, carbon, sodium, magnesium, aluminium, silicon, and barium have been investigated experimentally. The bands correspond with transitions of outer or conduction electrons into a vacant K or L shell, and the energy spread of the bands may be calculated approximately from the Sommerfeld theory of metals, which thus provides a method for determining the number of conduction electrons per atom. The characteristic properties of metals, semi-conductors (silicon), and insulators (carbon) are reflected in the sharpness of the X-ray band heads. For the true metals the calculated numbers of conduction electrons per atom agree with the normal valencies, except for aluminium, where the discrepancy is outside the limits of error.—W. H.-R.

***A Theory of the Form of the X-Ray Emission Bands of Metals. [Electron States in Metals.]** H. Jones, N. F. Mott, and H. W. B. Skinner (*Phys. Rev.*, 1934, [ii], 45, 379–384).—Theoretical. The results of O'Bryan and Skinner (preceding abstract) are investigated theoretically by an extension of the theory of Bloch (*Z. Physik*, 1928, 52, 555). The difference between the exact form of the bands in the different metals is explained.—W. H.-R.

Quantitative Crystal Analysis by X-Rays. M. E. Nahmias (*Z. Krist.*, 1932, 83, 329–339; *Brit. Chem. Abs.*, 1933, [A], 44).—Sources of error in previous methods are discussed and improvements are suggested. The essential difference in the new method is that the intensities of the lines of the substance to be determined are not compared directly with those of that pure substance, but both are compared with the lines of a third substance, e.g. aluminium. The powdered materials are stuck on fine (0.03 cm. diameter) aluminium wire which is moved helicoidally, thus averaging the composition of the material examined and diminishing errors due to heterogeneity. With quartz and kaolin and quartz and mullite results accurate to 10%, or with practice to 5%, are readily obtained. Cf. following abstract.—S. G.

Quantitative Crystal Analysis by X-Rays. M. E. Nahmias (*Z. Krist.*, 1933, 85, 319–321).—Cf. preceding abstract. Further details of the method are given.—S. G.

IV.—CORROSION

(Continued from pp. 240–245.)

Influence of Aluminium on Wine. Josef Schindler (*Vinařský Obzor*, 1932, 26, 86–88; *C. Abs.*, 1934, 28, 2461).—Aluminium, especially in combination with other metals, is corroded by contact with alcoholic beverages; beer and wine cause discoloration of aluminium and are made turbid by it. Fruit juices containing more sugar and acids have no effect.—S. G.

***Corrosion Experiments with Screws in Aluminium Alloys. Behaviour with the Application of Different Materials in Sea-Water and Sea-Air.** H. Bauermeister (*Z. Metallkunde*, 1934, 26, 34–37).—Cast KS-Seewasser alloy and Silumin containing screws of brass, iron, or phosphor-bronze were exposed to sea-water and sea-air, both separately and alternately for 47–169 days, and tests made to ascertain whether the screws could then be loosened. The results showed that brass screws were by far the best, that phosphor-bronze screws

were quite unsuitable, that greasing greatly assisted loosening, and that exposure to the wet and dry test caused more difficulty in removal than did permanent immersion in sea-water, especially if the samples had dried before testing. KS-Seewasser has a greater resistance than Silumin to corrosion by sea-water.—M. H.

A Recommended Test for Determining the Reactivity of Aluminium and Aluminium Alloys. H. Rohrig (*Korrosion u. Metallschutz*, 1934, 10, 38-39).—The following test provides a much more satisfactory method than the Mylius test for comparing the reactivities of aluminium after various heat and mechanical treatments: the specimen is pickled for 1 minute in 30% caustic soda solution at 90° C., rinsed, and dipped in concentrated nitric acid for 1 minute, then washed, dried, and weighed; it is then immersed for 1 hr. at 20° C. in a mixture of nitric acid 4, hydrochloric acid 1, and water 4 parts, again rinsed, dried, and weighed, the loss in weight in gm./m.^2 being a measure of the reactivity. The values obtained in this test for aluminium wire containing 0.16% silicon and 0.21% iron were (a) hard-drawn 348, (b) annealed for 30 minutes at 500° C. and quenched 19.6, (c) as (b) but slowly cooled 23.1, (d) as (b) but 300° C. 64.4, (e) as (c) but 300° C. 91.2.—A. R. P.

Condenser Tube Corrosion Research. R. May and F. A. Champion (*Trans. Inst. Marine Eng.*, 1933, 45, xi-xii).—The Annual Report of this Institute contains a summary of recent progress in the investigations of condenser tube corrosion carried out under the auspices of the British Non-Ferrous Metals Research Association, and deals with the influence of the nickel content on the various types of corrosion that may attack cupro-nickel tubes. Resistance to impingement attack increases gradually with increase in nickel content, becoming practically complete between 50 and 70% nickel, and the constituents have a somewhat similar influence on deposit attack. Intercrystalline attack and/or intercrystalline pitting is characteristic of the alloy with a nickel content of 50% or more, and has not been observed with 40% nickel or less. Evidence regarding the effect of the various constituents on oxide pitting is not yet conclusive. Reference is also made to work in progress on aluminium-brasses, the use of potential measurements in corrosion tests, and oxide pitting.—J. W. D.

Anodic Dissolution of Copper-Tin Alloys. J. W. Baimakow and P. B. Popow (*Zvetnye Metally (The Non-Ferrous Metals)*, 1932, 7, 513-536; *Chem. Zentr.*, 1934, 105, I, 2344).—[In Russian.] Contrary to statements in the literature, tin can be dissolved practically completely from copper-tin alloys by anodic dissolution if the following conditions are observed: the anode should contain at least 10-15% tin, the electrolyte should contain 150-175 gm./litre of sulphuric acid with 37 gm./litre of copper, and the temperature should not exceed 20° C. The electrolyte should be protected from the air by a layer of machine oil, and it should be adequately circulated; the current density at the anode should be 120-150 amp./dm.^2 and at the cathode 70-80 amp./dm.^2 . Addition of 0.6 c.c. of hydrochloric acid per litre assists in the production of smooth cathode deposits of copper; electrolysis can be continued until the copper content of the electrolyte falls to 10 gm./litre and the tin content rises to 50 gm./litre as stannous sulphate. The anodes should be well annealed and should be practically free from lead and zinc.—A. R. P.

Researches on the Corrosion of Various Leads of Different Chemical Composition in Sulphuric Acid Manufacture. Adolf Schünemann (*Korrosion u. Metallschutz*, 1933, 9, 325-331).—Tests on lead prepared by various processes and on alloys of lead with small quantities of other metals have shown that, for general use in sulphuric acid manufacture, the purest lead gives the best results. Addition of small quantities of copper, nickel, or bismuth may, under certain conditions and in certain parts of the plant, confer a higher corrosion resistance on the lead, but this is due to the formation of a protective film which later is broken down by local element action, and corrosion then proceeds more

rapidly than with pure lead. For parts which are subject to vibrational stresses such as would cause intercrystalline fatigue of pure lead, the use of lead containing a small quantity of copper is recommended.—A. R. P.

***An Investigation of the Corrosion of Magnesium Alloys. III.—The Effects of Heat-Treatments on the Corrosion of Magnesium-Zinc and Magnesium-Aluminium Alloys.** Takejirō Murakami and Susumu Morioka (*Kinzoku no Kenkyū*, 1934, 11, (3), 99-116).—[In Japanese.] By dipping specimens of magnesium-zinc and magnesium-aluminium alloys in dilute sodium chloride solutions, the corrodibility of the alloys was determined in the cast, annealed, quenched, and tempered conditions, and the effects of heat-treatment on the corrosion of the alloys were studied. The effect of tempering on the corrosion of magnesium-aluminium alloys is quite different from that of magnesium-zinc alloys. In the latter the corrodibility is a maximum when the precipitation of fine particles due to tempering of quenched specimens is a maximum, whereas in the former the corrodibility of the alloys treated under the same conditions is a minimum when the precipitation is maximum. In general, the cast specimens corrode less than the annealed and quenched ones; this fact leads to the conclusion that the heat-treatment of magnesium alloys has harmful results on their corrosion-resistance.—S. G.

***Concerning the Topochemistry of Magnesium. A Contribution to Our Knowledge of Metallic Corrosion.** A. Vyskočil (*Coll. trav. chim. Tchecoslov.*, 1934, 6, 1-16).—In aqueous solutions of ammonium salts or of salts of the alkalis or alkaline earths magnesium decomposes water, the hydroxide formed dissolving in the presence of ammonium salts. In acid solutions of ammonium salts the rate of dissolution of magnesium slowly decreases until neutrality is reached, then increases for a certain period, since slight alkalinity promotes the reaction in the presence of ammonium salts. Strongly alkaline solutions retard the reaction, the magnesium surface becoming resistant and retaining its metallic lustre. The catalytic effect of salts on the decomposition of water by magnesium is due solely to the anions, but oxidizing anions, e.g. chromate, passivate the metal; the anions are first adsorbed on discontinuities in the metal surface, and the free atoms of magnesium in the vicinity of the complexes formed then become activated for the reaction with water liberated from the hydrated anion adsorbed. The rate of formation of corrosion products on the magnesium surface depends on the adsorbability of the ions present, on the nature of the catalyzing ions (chloride ions being the most active), and on the nature of the metallic surface (whether made inhomogeneous by chemical action or originally so). The activity of the more active anions can be disturbed by the presence of less active ions which are more readily adsorbed, so that the magnesium surface may become more or less passivated for the action of the more active anions.—A. R. P.

Behaviour of Nickel and Alloys to Caustic Alkalis. H. E. Searle and R. Worthington (*Internat. Nickel Co. Bull.* No. T-6, 1933, 11 pp.; and (abstract) *Chem. and Met. Eng.*, 1933, 40, 528-529; *Bull. B.N.F.M.R.A.*, 1933, (58), 11).—Gives test data on the corrosion-resistance of nickel and its alloys to caustic alkalis of various concentrations and fused caustic soda, and a comparison with other metals, together with a *bibliography*.—S. G.

Attack of Metal Containers by So-Called Canned Fish in White Wine. Daniel Florentin (*Ann. Falsif.*, 1933, 26, 594-597; *C. Abs.*, 1934, 28, 2073).—Investigation of complaints regarding digestive disturbances alleged to have been caused by fish in so-called white wine (which are really fish in vinegar) showed that tin-coated cans were considerably attacked by the high acidity (even when they were not swollen or blown), most of the dissolved tin being fixed by the fish instead of remaining in solution in the liquid. With well-varnished containers the amount of tin dissolved was negligible.—S. G.

***The Corrosion of Zinc in Various Waters.** E. A. Anderson, C. E. Reinhard, and W. D. Hammel (*J. Amer. Waterworks Assoc.*, 1934, 26, 49-60).—Samples of

galvanized iron (hand-dipped after cutting to shape), 25.8 cm.² in area, were immersed for 1 day and 7 days in 140 c.c. of chlorinated water from Franklin, N.J., U.S.A., in distilled water, and in water to which 1, 3, and 5 p.p.m. of chlorine were added. Tests were done in quadruplicate with bottles loosely corked and sealed and the weights of zinc in solution, in suspension, and as adhering salts, together with loss of weight of the specimens, were determined. Distilled water dissolved sufficient zinc in 7 days to render it unfit for drinking, but the addition of 1-5 p.p.m. of chlorine greatly reduced the rate of attack. The available data concerning the maximum safe amount of zinc that can be contained in drinking water are reviewed, and it is tentatively suggested that 40 milligrams per litre might be a safe upper limit.—J. C. C.

Roofing Paper and Zinc Sheeting. H. Mallinson (*Teer u. Bitumen*, 1933, 31, 345-348; *C. Abs.*, 1934, 28, 2493).—Weathering action on zinc surfaces protected by asphalt and tar papers has been studied. Corrosion is caused by the action of condensed moisture and occurs with both types of paper. Provision for evaporation of condensed water prevents corrosion.—S. G.

Aluminized Roofing Paper. E. Tauber (*Teer u. Bitumen*, 1933, 31, 387).—S. G.

Accelerated Tests of Electroplated Metal Coatings on Steel. P. W. C. Strausser (*Monthly Rev. Amer. Electroplaters' Soc.*, 1934, 20, (5), 6-10; discussion, 11-16).—The ferroxyl test is shown to yield in a short time results for nickel and chromium-plated finishes which correspond exactly with their behaviour under ordinary atmospheric exposure.—A. R. P.

***Some Comparative Corrosion-Fatigue Tests Employing Two Types of Stressing Action.** H. J. Gough and D. G. Sopwith (*J. Iron Steel Inst.*, 1933, 127, 301-332; discussion, 333-335).—For abstract of the paper see *J. Inst. Metals*, 1933, 53, 309. In the discussion *F. Bacon* suggested that the fatigue limit in air: flexural value ratio might be modified by the creation of a concentric condition of self-stress as the Wöhler test proceeded, and this stress would rise to a sharp peak at the surface of the specimen. He expressed the opinion that the above ratio must be bound up in some way with the notch sensitivity under alternating stresses and with the capacity to raise the fatigue limit by preliminary understressing.—A. R. P.

The Corrosion of Metals by Gases at High Temperatures. A. Portevin, E. Pretet, and H. Jolivet (*Congrès du Chauffage Industriel* (Preprint), Group 1, Sect. 3, 1933, 33 pp.; *Bull. B.N.F.M.R.A.*, 1933, (60), 15).—Following a discussion of previous work, the authors describe their own results for the oxidation of electrolytic iron and binary alloys of iron with aluminium, chromium, and silicon. A full bibliography is appended.—S. G.

The Theories of Corrosion. O. A. Knight (*Mineral Ind., Pennsylvania State Coll.*, 1933, 3, (2), 2, 4; 1934, 3, (4), 3-4; *C. Abs.*, 1934, 28, 1647).—K. reviews the following theories of corrosion: the acid, film, peroxide, direct oxygen attack, colloidal, biological, and electrochemical. Soil corrosion and methods for combating atmospheric corrosion are discussed.—S. G.

V.—PROTECTION

(Other than Electrodeposition.)

(Continued from pp. 245-248.)

Electric Oxidation of Aluminium. The Eloxal Method. J. Loewenthal (*Teknisk Ukeblad*, 1933, 80, 561-564; *C. Abs.*, 1934, 28, 2275).—An electrolytic method is described for the coating of articles of aluminium or aluminium alloys with a 0.02-4 mm. film of γ -oxide. As a rule a.c. is employed, and no counter-electrodes are necessary. Articles of limited size are treated in rubber-lined sheet-iron vats at a temperature of 15°-30° C. In most cases 3.5-4.5 kw.-hrs. per m.² surface will be sufficient, the treatment being completed in

15–20 minutes. Wire or ribbon is drawn continuously through the bath. Tube spirals and similar articles that cannot be treated in the bath are treated by means of a special spraying apparatus, the article being grounded and serving as one electrode, the electric current playing between the sprayed surface and a counter-electrode on the spraying apparatus through the jet of an electrolyte. The latter is an acid solution containing oxidative substances, no further details being stated. The oxide film can be coloured by treatment with solutions of organic or mineral dyestuffs. The oxide film obtained by the Eloxal process is claimed to be far better than any other oxide coatings with respect to electrical resistance, non-porosity, and chemical resistivity.—S. G.

Anodic Oxidation of Aluminium. C. L. Mantell (*Metal Cleaning and Finishing*, 1934, 6, 11–16, 29; *C. Abs.*, 1934, 28, 2625).—The production of oxide films on aluminium for protective and decorative purposes by the use of chromic acid and the sulphuric acid anodic oxidation processes is described in detail. The composition of such films and their electrical, chemical, and mechanical properties are discussed. Paint, varnish, and other coating materials adhere much better to aluminium thus treated. The colour of the oxide films may be varied, depending on the purity of the aluminium, the electrolyte, and the operating conditions.—S. G.

Anodic Treatment and Dyeing of Aluminium Castings. N. D. Pullen (*Proc. Inst. Brit. Found.*, 1932–1933, 26, 335–345; discussion, 346–347).—*Sec J. Inst. Metals*, 1933, 53, 444.—S. G.

Copper-Coating of Aluminium Parts in the Cold. Anon. (*Metallwaren-Ind. u. Galvano-Tech.*, 1934, 32, 118–119).—The articles are polished brightly on linen wheels, then immersed in a mixture of 10 vol. of hydrochloric acid and 60 vol. of water, to which are added 2 parts of sulphuric acid and 2 parts of copper sulphate. After well rinsing, the copper deposit is burnished, and the article is then hung in a bath containing 38 grm. of copper sulphate and 0.8 grm. of potassium chloride in 135 c.c. of water until the desired thickness of copper is obtained. The deposit adheres well, and the coated article may be mechanically worked without flaking occurring.—A. R. P.

Protection from Deterioration of Lead Sheaths of Cables. A. Noirclerc and L. Lussaud (*Rev. gén. Élect.*, 1933, 34, 19–28; *Sci. Abs.*, 1933, [B], 36, 555).—Various causes of the deterioration of the lead sheaths of cables, telephone, telegraph, or power, are described. The causes dealt with are: (1) mechanical, such as tension or crushing when the cables are being handled; (2) inter-crystallization due to vibration; (3) chemical action due to the reagents in the soil or atmosphere; and (4) electrochemical action due to stray currents. It is pointed out that the mechanical strength can be increased by alloying the lead with tin, antimony, or cadmium. Protection against chemical and electrochemical corrosion may be obtained by coating the lead with a layer of a composition of sulphur and mercury, and tables are given showing the results of tests of samples of lead that have been treated with this composition. Care should be exercised in the selection of the routes along which to run the cables.—S. G.

***Tin-Iron Alloy in Tinplate, with Notes on Some Imperfections.** W. E. Hoare (*Iron Steel Inst. Advance Copy*, 1934, (May), 1–12).—The structure of the compound layer occurring in commercial tinplates has been investigated. The compound is FeSn_2 , no other compound or iron-tin phase of any kind has been observed. Certain defects which occur are classified as “normal pores” and “potential pores,” the former being true pores immediately after the tinning of the plate and the latter tending to become true pores during forming. Microscopic examination shows that both the “hot-water” and the “modified ferricyanide paper” tests register an exposure of the steel base, but give no reaction with FeSn_2 crystallites. The low results given with the latter tests can be obviated by correct dampness of the paper and careful exclusion of minute air

bubbles. The hot-water test is considered as the standard test, although the ferricyanide paper test is the more convenient. The following defects were noted, their nature investigated, and suggestions made as to their causes: normal pores, blisters, mottle, dry patches, grease lines, and isolated FeSn_2 crystallites.—J. H. W.

Hot-Galvanizing and Lead-Coating [of Metals]. Anon. (*Metallwaren-Ind. u. Galvano-Tech.*, 1934, 32, 91-93).—An account of modern technique in these processes.—A. R. P.

Galvanization, a Means of Protecting Ferrous Metals Against Atmospheric Corrosion. Marcel Lepingle (*Science et Industrie*, 1934, 18, 110-114).—(See also *J. Inst. Metals*, 1933, 53, 638; and *Met. Abs.*, this volume, p. 182.) Results of service tests on galvanized material are discussed and summarized, notably those carried out by the American Society for Testing Materials. A bibliography is given.—P. M. C. R.

Paints for Aluminium and Its Alloys. H. Rabaté (*Peintures, Pigments, Vernis*, 1933, 10, 64-65, 67-69; *C. Abs.*, 1934, 28, 2201).—A general account is given of the suitability of coatings made from oils, asphalt, tar, nitrocellulose, and synthetic resins, and of the preparation of the metal surfaces.—S. G.

Review of Rustproofing Processes with Reference to the Use of Town's Gas. O. W. Roskill (*Metallurgia*, 1934, 9, 185-188).—Rustproofing processes, both by actual physical deposition of the protective coating on the surface of the metal, and by transforming the surface of the metal itself chemically into a protective coating, are dealt with. Spraying with tin, lead, zinc, aluminium, or nickel; Sherardizing, the Parker process, Coslettizing, and anodic oxidation are among the processes which are discussed in brief detail, not only with regard to the general technique involved, but also with special reference to the use of town's gas in the various furnaces required. Reference is also made to the types of deposit obtained, to the applications of the various processes, and to recent developments which have taken place in their technique and applications.—J. W. D.

A New Metal Spraying Process for Coating Iron and Steel. Anon. (*Illust. Z. Blechindustrie*, 1934, 63, 355).—A recent development of the Schoop spraying process includes subsequent heat-treatment after the application of an aluminium coating. It is claimed that interaction between the basis metal and the aluminium produces a perfect bond, the coating being stable at working temperatures up to 1000°C ., at which temperature the life of the coated material is estimated at 8 times that of the original; values for lower service temperatures are given. Graphite and sulphur present in grey iron may weaken the coating by combination with the aluminium.—P. M. C. R.

Paints for Aluminium and Its Alloys. H. Rabaté (*Synthetic and Applied Finishes*, 1933, 4, 219-220, 222).—See *Met. Abs.*, this volume, p. 19.—S. G.

Painting Elektron. Fr. Kolke (*Farben-Zeit.*, 1933, 38, 1756; *C. Abs.*, 1934, 28, 1875).—A Bakelite primer containing 30% TiO_2 , baked on, was the best of several for the magnesium alloys A2M and AM 503. Chromatizing pre-treatment also favourably affected the durability of the paints.—S. G.

Study of Rust-Preventing Power of Paints on Tinned-Iron Food Containers. A. Vila (*Recherches et Inventions*, 1933, (228), 308-318).—S. G.

The Use of Metallic Zinc Paint for the Protection of Metal [Zinc and Zinc-Coated] Surfaces. H. P. Fritsch (*Agric. Eng.*, 1933, 14, 337-338; *C. Abs.*, 1934, 28, 2549).—Owing in part to its chemical composition and in part to its unusual distensibility, metallic zinc paint affords much better adherence to zinc and zinc-coated surfaces than many other paints commonly used for this purpose.—S. G.

The Function of Paint as a Metal Preservative. L. A. Jordan *et al.* (*J. Oil Colour Chem. Assoc.*, 1933, 16, 398-421).—A discussion.—S. G.

VI.—ELECTRODEPOSITION

(Continued from p. 248.)

Cadmium Plating on Full Automatic Machines. F. L. Greenwald (*Monthly Rev. Amer. Electroplaters' Soc.*, 1933, 20, (3), 19-25; discussion, 25-26).—The work is degreased anodically in an electric cleaner, then pickled in 20% hydrochloric acid for 1 minute at 50° C., rinsed in a water-spray, and cleaned cathodically for 1 minute with 20 amp./ft.² in a bath containing 5 oz./gall. of sodium cyanide; it is then transferred without washing to the plating bath, which contains cadmium 2, free cyanide 6, and sodium carbonate 5 oz./gall. and is operated at 25-30 amp./ft.² for 6 minutes, after which the plated articles pass through a series of cold- and hot-water washes and sprays, then into a drying oven at 175° C.—A. R. P.

Analytical Control of Cadmium Electro-Plating Solutions. E. E. Halls (*Metallurgia*, 1934, 9, 183-184).—The necessity of analytical control to ensure the maximum utility of the cadmium plate is discussed. The determinations which it is necessary to make are total cadmium content, free cyanide content, and alkalinity, present as hydroxide and carbonate. The procedure necessary before making the determinations is first considered, then different methods for the determination of cadmium, volumetric and electrolytic, are given, as well as methods for the determination of the free cyanide content, and the alkali present as carbonate and hydroxide.—J. W. D.

Iron in Chromium[-Plating] Baths. Oskar Krämer (*Metallwaren-Ind. u. Galvano-Tech.*, 1934, 32, 90, 118).—The sources of contamination of the bath with iron, the deleterious effect thereof on the plating process, and means for removing iron from contaminated baths are briefly discussed.—A. R. P.

Chromium Plating in the Cold. O. Macchia and D. Raffaelli (*Indust. meccanica*, 1933, 15, 793-795; *C. Abs.*, 1934, 28, 1606).—A discussion of the problem of plating chromium at 30°-50° C. as contrasted with that at 16°-20° C. It is concluded that plating in the cold is entirely practicable and possesses the following advantages over the heated-bath method: the heating apparatus and the expense of its operation are eliminated; a smaller current density may be used, in consequence of which a smaller investment in the generating plant and its operation is required; the apparatus required for ventilation on account of harmful vapours is reduced to a minimum.—S. G.

†**Protection of Workers Exposed to Chromium and Its Compounds.** Anon. (*Monthly Rev. Amer. Electroplaters' Soc.*, 1934, 20, (7), 39-47).—Symptoms, cure, and methods of preventing diseases caused by spray from chromium plating tanks are described.—A. R. P.

On the Effect of Chromium in Nickel Plating Baths. F. Pietrafesa (*Atti Congr. naz. Chim. pura appl.*, 1933, 4, 776-785; *Chem. Zentr.*, 1934, 105, I, 1384).—Even very small quantities of chromic acid in nickel-plating baths, impart a leady appearance to the deposits due to the formation of colloids which are deposited on the cathode by cataphoresis and cause the formation of gas bubbles. Prolonged electrolysis regenerates the baths.—A. R. P.

Chromium Plating. A. Guillerot and J. Pierson (*Bull. Soc. franç. Élect.*, 1933, 3, 859-866; *Sci. Abs.*, 1933, [B], 36, 603).—Low-temperature methods (15° C., current density 3-5 amp./dm.², with additions to the chromic acid electrolyte have been examined. The authors do not anticipate much development, but consider that eventual improvement may lie in the adoption of trivalent chromium salts in the electrolyte instead of chromic acid.—S. G.

***On the Question of the Chromium Plating of Nickel Films.** Joachim Koriun, Ernst Vogel, and Karl Schneider (*Naturwiss.*, 1934, 22, 135).—The peeling of nickel plate during or after chromium plating is attributed to the diffusion of hydrogen through the nickel layer with the development of a hydrogen

pressure. The diffusion of hydrogen through nickel films which have a tendency to peel is particularly strong and the grain size correspondingly small.—J. W.

Production of Thick Brass Coatings on Iron and Steel. Anon. (*Metallwaren-Ind. u. Galvano-Techn.*, 1934, 32, 94).—A cheaper way than electroplating with brass direct from a cyanide bath is to plate alternately with copper and zinc from separate acid baths, then to heat the article to cause diffusion of the two metals to produce brass. Flaking of the first zinc coating from the steel is prevented by first applying a thin nickel coat.—A. R. P.

The Use of Acids in the Preparation of Steel for Plating [with Copper and Nickel]. Walter S. Barrows (*Monthly Rev. Amer. Electroplaters' Soc.*, 1933, 20, (3), 12-18; discussion, 18).—Practical hints on acid cleaning before plating.—A. R. P.

***The Electrodeposition of Copper, Nickel, and Zinc Alloys from Cyanide Solutions.**—I. Charles L. Faust and G. H. Montillon (*Electrochem. Soc. Preprint*, 1934, (April), 267-281).—Copper-nickel-zinc alloys can be deposited from cyanide solutions, the colour of the deposit varying from golden-yellow to platinum-white, according to the conditions of deposition. Zinc deposits more readily than copper, and copper more readily than nickel; the copper content of the alloy is relatively greater than the proportion of copper in the bath, that of zinc about the same as the zinc content of the bath, and that of the nickel much less than the % of nickel in the bath. Increase in current density increases the zinc and nickel contents of the deposit, and increase in temperature the copper content. Curves are given showing the composition of alloys deposited under various conditions of temperature and current density.—A. R. P.

Deposition of Pink Gold. Alfred K. Pritchard, Jr. (*Met. Ind. (N.Y.)*, 1933, 31, 408).—The bath contains sodium phosphate crystals 60, sodium cyanide 3, nickel cyanide 3, palladium (as chloride) 3, gold (as aurous cyanide) 0.25, and copper cyanide 0.5 gm./litre, it is operated at 55°-65° C. with 4-6 v., using nickel or hard carbon anodes. High temperatures favour deposition of nickel and palladium, low temperatures deposition of gold and copper; by careful regulation a pink gold alloy is deposited.—A. R. P.

***The Electrodeposition of Indium from Cyanide Solutions.** Daniel Gray (*Electrochem. Soc. Preprint*, 1934, (April), 283-286).—The bath is prepared by dissolving indium in hydrochloric acid, expelling the excess of acid, precipitating the indium as hydroxide with ammonia, dissolving the precipitate in saturated sodium cyanide solution containing 0.5 gm. of dextrose per 1 gm. of indium, and diluting until the indium concentration is 60 gm./litre. The bath remains stable for at least 2 years, and can be boiled without deposition of hydroxide. Operating at 1-16 amp./dm.² soft silver-white deposits are obtained at 100% current efficiency when the bath is new, but at only 50% efficiency with old baths. Indium anodes cannot be used, but good results are obtained with platinum or other insoluble anodes.—A. R. P.

***Ductility and Adhesion of Nickel Deposits.** F. P. Romanoff (*Electrochem. Soc. Preprint*, 1934, (April), 251-256).—The ductility of nickel deposits depends on the crystal structure, amount of adsorbed gas, and the presence or absence of entrapped basic salts. Hard nickel deposits have an acicular or columnar structure or contain adsorbed gas or basic compounds, whereas ductile deposits are free from inclusions, and consist of conical or pyramidal crystals. Ductile deposits up to 0.01 in. thick have practically no effect on the ductility of the base metal, but fibrous non-ductile deposits cause an apparent hardening of the base metal probably due to notch propagation by transmission from fractures produced in the nickel deposit by the deformation applied. The inherent ductility of copper remains unaffected by plating with fibrous nickel, since when the latter is removed the copper is just as ductile as it was before plating. A ductile nickel deposit on copper can be embrittled by cathodic treatment in an alkaline solution, but chromium may be deposited on a ductile

deposit without causing embrittlement. The most reliable method for determining the adhesion and ductility of nickel and other coatings on sheet metal consists in stamping out a flanged cap. Examples of stampings made from copper and brass plated with ductile nickel are shown.—A. R. P.

Some Problems in Technical Control of Nickel-Plating Production. F. A. Maurer (*Monthly Rev. Amer. Electroplaters' Soc.*, 1934, 20, (8), 42-48).—A brief account of the methods used in the nickel-plating of flat-irons.—A. R. P.

Rhodium Plating. Osvaldo Macchia (*Indust. meccanica*, 1933, 15, 621-622; *C. Abs.*, 1934, 28, 1606).—A review of rhodium in electroplating, covering the published researches and the proposed baths.—S. G.

Production of Electrolytic Cadmium-Silver Plate. Ralph W. Harbison (*Deut. Goldschmiede-Zeit.*, 1933, 36, 525-526; *Chem. Zentr.*, 1934, 105, I, 759).—Silver-cadmium deposits from cyanide baths have good mechanical properties, but poor resistance to sulphide tarnishing when the cadmium content is less than 25%; with more than 70% cadmium they are hard and fairly resistant to tarnishing, but with 25-70% cadmium brittle and useless. Suitable baths for obtaining good deposits contain cadmium 80-90, silver 10-25, and sodium cyanide 17-18 gm./litre.—A. R. P.

Throwing Power of Zinc-Plating Solutions. I.—Relation Between Current Density and Current Efficiency of Zinc Sulphate Solutions. Masami Nakajima (*J. Electrochem. Assoc. (Japan)*, 1934, 2, 19-25; *C. Abs.*, 1934, 28, 1931).—[In Japanese.] The p_H values of 0.5, 1.5, and 2.5*N* zinc sulphate solutions have been determined and compared with each other. On the basis of quality of deposit and current efficiency, 1.5-2.5*N* zinc sulphate solution at 3.4 p_H and 1-3.5 amp./dm.² is recommended.—S. G.

Discussion of the Applications of Electrodeposition to Printing. H. E. Boughay (*Met. Ind. (Lond.)*, 1934, 44, 377-379).—Abstract of the discussion of a paper read before the Electrodepositors' Technical Society. See *Met. Abs.*, this volume, p. 137.—J. H. W.

Filtration of Plating Solutions. Louis Weisberg and Willard F. Greenwald (*Met. Ind. (N.Y.)*, 1934, 32, 15-18).—The operation of the following types of filters is discussed: presses, leaf filters, and asbestos disc filters. Means for circulating plating solutions and the cost of filtration are also considered.

—A. R. P.

Methods of Stripping Plated Coatings [from Steel]. A. Brenner (*Monthly Rev. Amer. Electroplaters' Soc.*, 1933, 20, (3), 7-10; discussion, 11-12).—See *Met. Abs.*, this volume, p. 248.—A. R. P.

VII.—ELECTROMETALLURGY AND ELECTROCHEMISTRY

(Other than Electrodeposition and Electro-Refining.)

(Continued from pp. 248-249.)

Investigations on the Influence of Aluminium Salts on the Electrolysis of Zinc Sulphate Solutions. L. Wasilewski and A. Weber (*Przemysl Chem.*, 1933, 17, 259-267; *Chem. Zentr.*, 1934, 105, I, 1551).—In the production of electrolytic zinc from solutions containing 90 gm./litre of zinc as sulphate and 3.3 gm./litre of free acid using lead anodes and aluminium cathodes, addition of 0.9 gm./litre of aluminium sulphate results in the production of smooth adherent deposits, which show no tendency to "tree" even at the edges, and increases the current yield; if hydrogen bubbles are allowed to accumulate on the cathode, however, the beneficial effect of the aluminium salt is nullified. With larger additions of aluminium sulphate the current yield at 1-4.3 amp./dm.² is further increased up to a maximum with 3.6 gm./litre of sulphate, and then falls rapidly until with 9 gm./litre an effect is obtained similar to that produced by cobalt.—A. R. P.

*The Electrolysis of Metals Studied with Scraped Electrodes. J. Hoekstra (*Coll. trav. chim. Tchecoslov.*, 1934, 6, 17-36).—Irregular current-voltage curves are obtained with unscraped silver electrodes in *M*-silver nitrate solution, whereas straight lines are obtained with scraped electrodes. Copper electrodes behave similarly to silver, but mercury always gives a straight-line relation. Scraping eliminates slight irregularities in the curves for lead electrodes, but has a profound effect on the curves for zinc electrodes. With nickel electrodes scraping prevents polarization. Photomicrographs are given of growing deposits of silver, copper, lead, tin, and thallium. A theoretical explanation of the effects observed is given based on activation and adsorption phenomena.

—A. R. P.

Electrochemistry and Electrometallurgy—1932-1933. — (*Elect. Eng.*, 1933, 52, 706-707).—Excerpts from the annual report of the A.I.E.E. committee on the subject. It is stated that the commercial production of lithium has been established in America. It is being extensively used as a hardener for aluminium and lead alloys and the degassing of copper, where it is of particular importance in connection with the manufacture of H.-C. copper.—S. V. W.

IX.—ANALYSIS

(Continued from pp. 250-252.)

*Spectrographic Investigations of Technical and Very Pure Metals. III.—Aluminium. Walther Gerlach and Else Riedl (*Sitzber. math. naturw. Abt. bayer. Akad. Wiss. München*, 1933, (2), 227-236; *C. Abs.*, 1934, 28, 1625).—*Cf. Met. Abs.*, this volume, p. 25. Spectrograms in the region 3900-4300 Å. are given for Al from several sources. All the impurities can be detected. Chemical analyses for Fe and Si in the purer sorts agree well with the spectral determination but not for the impure samples. Ga was found in considerable quantities in nearly all samples. Sc but no Ga was found in Al from the Aluminum Company of America. The relative amounts of Ag, Cr, Cu, Fe, Ga, Mn, Ni, Pb, Sc, Si, Sn, Ti, V, and Zn are estimated in each sample.—S. G.

Kinematographic Process of Quantitative Spectrum Analysis. A. Betim (*Boletim do Museu Nacional (Rio de Janeiro)*, 1933, 9, (3), 52 pp.; *Bull. B.N.F.M.R.A.*, 1934, (65), 11).—[In French.] The principle of the method rests on the measurement of the mass of the elements present in a (mineral) sample by means of variation of one of the lines. A photographic plate is displaced in the direction of the spectrum lines, thus giving a record both of intensity and duration of emission. Integration of intensity and time factor gives mass.—S. G.

Analysis of Babbitt Metal. Frank W. Scott (*Chemist-Analyst*, 1934, 23, (2), 10-11, 14-15).—Details are given for the determination of Pb as PbSO₄, Fe as Fe₂O₃, Cu by electrolysis, Sb by titration with KMnO₄, and Sn by titration with I₂.—A. R. P.

Electroanalysis of Molybdenum. Chujiro Nemoto and Yoshio Tanabe (*J. Electrochem. Soc. (Japan)*, 1934, 2, 53-56; *C. Abs.*, 1934, 28, 2296).—[In Japanese.] Add 0.5 gm. CH₃COONH₄ to the aqueous solution containing 0.1 gm. MoO₃ as (NH₄)₂MoO₄, dilute to 150 c.c., heat to about 70° C. and electrolyze with a current of 0.2 amp. for 5 hrs. and with a cathode of Pt gauze plated with Cu. Add 1 c.c. of 50% CH₃COOH at the middle of the electrolysis. After complete precipitation, wash the deposit with hot water without breaking the circuit, rinse with alcohol, dry and weigh.—S. G.

*The Analysis of High-Grade Ferrosilicon. Paul Klinger (*Arch. Eisenhüttenwesen*, 1933-1934, 7, 551-556).—Methods are given for the determination of C, Mn, P, S, Al, Ti, Ca, Mg, Cu, Fe, Si, and SiO₂.—J. W.

Methods of Detecting Arsenic. Roberto Intonti (*Atti Congr. naz. Chim. pura appl.*, 1933, 4, 732-737; *Chem. Zentr.*, 1934, 105, I, 1527).—Modifications of the Reinsch test are described.—A. R. P.

*On the Reaction of Bismuth with Thiourea. J. V. Dubský, A. Okáč, and B. Okáč (*Z. anorg. Chem.*, 1934, **216**, 386-390).—HNO₃ solutions of Bi salts yield an intense yellow colour with thiourea.—M. H.

*The Detection of Copper by Means of *p*-Phenylenediamine. R. J. McIlroy (*Analyst*, 1934, **59**, 103).—Addition of 5 c.c. of saturated KCNS solution and 2-3 drops of *p*-phenylenediamine to a feebly ammoniacal solution containing Cu yields a black precipitate; Co, Mn, Ni, and Mg give no precipitate, Cd, Zn, and Ag white precipitates, and Hg a grey precipitate.—A. R. P.

Notes on the Determination of Aluminium in Nickel Alloys. R. C. Chirnside (*Analyst*, 1934, **59**, 278).—The cold, feebly acid solution is treated with KCN until all the Ni and Cu are converted into complex cyanides, and the mixture is then poured slowly with constant stirring into excess of dilute NH₄OH. The precipitate of Al(OH)₃, Cr(OH)₃, and Fe(OH)₃ is allowed to settle, collected, washed with 2% NH₄NO₃ solution, and analyzed as usual.—A. R. P.

Determination of the Lead Content of Tinned Containers. E. Wohnlich (*Z. Untersuch. Lebensm.*, 1933, **66**, 453-460; *C. Abs.*, 1934, **28**, 1626).—A discussion of methods.—S. G.

*On the Quantitative Determination of Some Metals with Anthranilic Acid. III.—A Simple Method for the Quantitative Determination of Manganese. H. Funk and M. Demmel (*Z. anal. Chem.*, 1934, **96**, 355-358).—The neutral solution (80 c.c. for every 0.1 gm. Mn) is treated with 60 c.c. of cold 3% Na anthranilate solution. The precipitate of Mn (C₇H₆O₂N)₂ is collected in a porous crucible washed with a 0.5% solution of the reagent, then with C₂H₅OH, dried at 105°-110° C., and weighed; it contains 16.795% Mn.—A. R. P.

Nephelometry. III.—Determination of Phosphorus in Steels and Arsenic in Arsenical Copper. Luigi Belladen, Ugo Scazzola, and Renato Scazzola (*Annali chim. applicata*, 1933, **23**, 517-521; *C. Abs.*, 1934, **28**, 1953).—Determine As in alloys by the method of Kleiman and Pangritz but use the strychnine-molybdic acid reagent instead of the cocaine derivative.—S. G.

Chemical Researches on Galvanizing and Rapid Methods for the Determination of Zinc on Galvanized Iron. E. Azzarello, A. Accardo, and A. Scalzi (*Atti Congr. naz. Chim. pura appl.*, 1933, **4**, 629-656; *Chem. Zentr.*, 1934, **105**, I, 1554).—*Cf. Met. Abs.*, this volume, p. 27. The properties of galvanized Fe prepared by various processes are described and methods of determining the Zn are critically discussed. The most rapid method consists in dissolving off the Zn in dilute H₂SO₄ containing MgSO₄, measuring the H₂ evolved, and determining the Fe⁺⁺ in solution by titration with 0.05N-KMnO₄; the H₂ equivalent to the Fe is deducted from the total, and the remainder calculated to Zn. Another procedure consists in dissolving the greater part of the Zn in 100 c.c. of 2% H₂SO₄, treating the solution with 2 gm. of tartaric acid and 6 gm. of NaOH, and electrolyzing, using the partly stripped Fe as anode and a Cu gauze cathode; the Fe and Pb in the deposit must be determined by the usual methods and deducted from the weight.—A. R. P.

X.—LABORATORY APPARATUS, INSTRUMENTS, &c.

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

(Continued from pp. 252-253.)

*A New Optical Dilatometer.—II. Fr. Bollenrath (*Z. Metallkunde*, 1934, **26**, 62-65).—*Cf. J. Inst. Metals*, 1933, **53**, 650. Determinations with a highly sensitive dilatometer have been made of the thermal expansion curves of aluminium (99.87%), magnesium (99.96%), extruded Elektron V1w (containing aluminium 10.0, and manganese 0.4%), cast Silumin, and cast 90 : 10 aluminium-copper alloy. The coeff. of thermal expansion of these materials are given.—M. H.

***The Expansion Characteristics of Some Common Glasses and Metals.** E. E. Berger (*Gen. Elect. Rev.*, 1934, **37**, 93-96).—A description of an apparatus for measuring expansion. The expansion of the sample is compared with that of a sample of known expansion, the difference being measured by means of the rotation of a small mirror mounted on a roller between extensions to the two samples. The furnace, which is mounted vertically, and method of mounting the specimens are described. Samples up to 12 in. long can be used. Some typical results are given.—S. V. W.

†**Magneto-Caloric Production of Extremely Low Temperatures.** W. Meissner (*Physikal. Z.*, 1934, **35**, 303-310).—The literature relating to the production of extremely low temperatures by utilizing the magneto-caloric properties of bodies is reviewed. Briefly, the method is as follows: a paramagnetic body is magnetized isothermally at a high temperature; the heat evolved is transferred to a cooling medium; the body is then demagnetized adiabatically out of contact with the cooling medium; in the case of some paramagnetic bodies further cooling is thus produced. Temperatures very close to absolute zero have been attained in this manner.—J. S. G. T.

***Apparatus for the Preparation of [Rods of] High Melting Alloys.** F. Beck (*Z. tech. Physik*, 1933, **14**, 544-556).—A vacuum sintering apparatus with optical and electrical control of the temperature is described for the manufacture of sinter rods of high melting point metals and alloys.—J. W.

XI—PHYSICAL AND MECHANICAL TESTING, INSPECTION, AND RADIOLOGY

(Continued from pp. 254-256.)

Some Tests of Intermetallic Abrasion. H. W. Swift (*Engineering*, 1931, **131**, 783-785; and (abstract) *Organ Fortschritte Eisenbahnwesen*, 1932, **87**, 183-184).—The testing machine consists essentially of a cylindrical drum, the flat annular end of which rubs against 3 evenly spaced specimens of the material to be tested. Either the whole drum or the annular portion is made of some selected abrading medium. Lubrication is not applied, and only sliding abrasion is considered. The loss of weight of the 3 specimens together is found after every 20,000 revolutions, the test normally covering 250,000-500,000 revolutions. Friction readings are taken periodically. Results are tabulated for 3 steels, cast iron, phosphor-bronze, and "Halo," a synthetic brake-lining. Certain induced surface effects are noted as requiring further investigation.

—P. M. C. R.

Suitability of the Torsion Test for Following the Course of Corrosion. B. Garre and H. Brose (*Korrosion u. Metallschutz*, 1933, **9**, 334-336).—Tests on copper and aluminium wire have shown that the torsion test provides an accurate indication of the nature and degree of corrosion which the wire has undergone.—A. R. P.

Applications of Some Machines for the Testing of Metals. Gérard de Smet (*Machine moderne*, 1934, **38**, (296), 7-11).—Testing methods in general use are classified, and the advantage to the constructor of systematic testing is emphasized. The working of the following types of machine is discussed: tensile; impact; repeated shock; fatigue; Brinell, Shore, Herbert, and Rockwell hardness and wear-testing machines.—P. M. C. R.

A Method for Non-Destructive Testing of Weld Seams. S. Kiesskalt (*Autogene metallbearbeitung*, 1934, **27**, 65-68).—A description of the I.G. electro-acoustic weld tests in which magnetic lines of force, induced in the material to be tested, are "tracked" by a portable instrument connected to a pair of headphones. The characteristic sound produced is varied by the presence of flaws or inclusions. Although primarily intended for ferrous materials, the tester is said to be applicable to nickel welds.—H. W. G. H.

Characteristics of Strength of Metals at High Temperatures. M. Ros and A. Eichinger (*Congrès du Chauffage Industriel* (Preprint), Group 1, Sect. 3, 1933, 11 pp.; *Bull. B.N.F.M.R.A.*, 1933, (60), 15).—Discusses mathematical aspects, typical curves, &c., for static and alternating tests, with notes on Amsler testing machines in use at the Swiss Federal Testing Laboratory, Zurich.—S. G.

RADIOLOGY.

Future of Technical Radiology. C. N. Kemp. (*Brit. J. Radiology*, 1933, 6, 166–172; discussion, 172–174; *Sci. Abs.*, 1933, [B], 36, 328).—Possibilities of using X-ray examinations in directions other than medical are reviewed. Where more simple methods of investigation are available, at less cost, the method is not applicable, but there are many problems in industry where the X-ray method can be applied to otherwise insoluble problems. For this purpose the apparatus should be specifically designed for the investigations in question and be as simple as possible. Whereas in France and Germany industrial radiology is widely used, in Great Britain manufacturers of X-ray apparatus report that, apart from medicine, the volume of business in respect of the applications of X-rays is practically nil. Education in this respect is greatly needed and K. offers various suggestions. A discussion followed.

—S. G.

Recent Results of the Radiometallographic Examination of Castings. René Leonhardt (*Machine moderne*, 1934, 38, (296), 19–21).—See *Met. Abs.*, this volume, p. 199.—P. M. C. R.

†**Application of X-Ray Fine Structure Research to Technical Problems.** Franz Wever (*Arch. Eisenhüttenwesen*, 1933–1934, 7, 527–530).—Important results of röntgenography, especially in the solution of technical problems, are described. The use of X-rays in technical practice is difficult, but yields valuable information.—J. W.

Possible Uses of X-Rays in the Determination of Internal Stresses in Materials and Constructional Parts. R. Berthold (*Z. tech. Physik*, 1934, 15, 42–48).—A review of recent work.—J. W.

Radiometallography Applied to Welding. Anon. (*Machine moderne*, 1934, 38, (297), 66–67).—An account of an improved radium-tube apparatus for the examination of metals; the effects of variations of thickness in the material examined are obviated by immersion in a liquid of similar permeability to X-rays.—P. M. C. R.

X-Ray Testing Apparatus. W. E. Schmid (*Arch. tech. Messen*, 1934, 3, (33), r41–r42).—A review of X-ray testing plant for investigating either macro- or micro-structures. Some details of suitable current strengths are given for various metals of stated thickness. For microstructures, a table gives wave-length, filter, and voltage for anodes of chromium, iron, cobalt, copper, molybdenum, and tungsten.—P. M. C. R.

XII.—TEMPERATURE MEASUREMENT AND CONTROL

(Continued from p. 256.)

***A Circuit Doubler for Use with a Dotting Recorder [for Thermocouples].** H. E. Beckett and H. Sheard (*J. Sci. Instruments*, 1934, 11, 111–113).—In recording electrical quantities (*e.g.*, thermocouple readings) by galvanometers with dotting and circuit changing mechanisms, the frequency of dotting is often greater than is necessitated by the rate of change of the quantity measured. A circuit doubler is described for use on thermocouple circuits with a six-point thread recorder made by the Cambridge Instrument Co., Ltd., which enables

12 records to be obtained simultaneously. It can be modified for use with any standard type of dotting recorder.—W. H.-R.

A Thermostat for Higher Temperatures. Břetislav G. Šimek and Jevgenij Zamrzla (*Mitt. Kohlenforschungsinst. Prag*, 1933, 485-489; *C. Abs.*, 1934, 28, 1578).—The thermostat is based on the principle that if the pressure on a boiling liquid is held const. to within 1 mm. mercury, the temperature of the thermostat, which is heated by saturated vapour, can be held const. to within $\frac{1}{18}^{\circ}$. A vacuum regulator is used to regulate the pressure. A diagram shows the saturation pressures of several liquids suitable for thermostat material. By using a suitable construction material, liquid and condensation temperature this principle can be applied to the regulation of very low or relatively high temperatures.—S. G.

Expansion-Rod Thermostatic Regulators. L. Nolte (*Elektrotech. Z.*, 1933, 54, 798-799; *Sci. Abs.*, 1933, [B], 36, 627).—Alternative methods of securing automatic control of temperature in electric furnaces are noted briefly. An expansion-bar regulator comprises the actual regulating bar and switch-gear controlling the heating circuit. The operative device generally consists of a rod of material of low coeff. of expansion enclosed in a tube having a higher coeff. of expansion. The effect of conductivity is reduced by dividing this device into active and indifferent lengths. Curves are given showing the range of temperature between switching on and off, as a function of the depth of immersion of the expansion device. The calculation of the controlling force developed under stated conditions is explained, and notes are included on the desirable degree of mechanical magnification of movement, the behaviour of various contact materials, and the suppression of sparking.—S. G.

Temperature Control of Electric Furnaces. M. Lang (*Elektrotech. Z.*, 1933, 54, 789-791; *Sci. Abs.*, 1933, [B], 36, 627).—Cf. *J. Inst. Metals*, 1933, 53, 515. L. describes the developments in the temperature control of industrial furnaces, contrasting the features of aperiodic control and other systems which aim at closeness of control, speed of operation, and protection from overheating should the regulator fail.—S. G.

Constant-Temperature Apparatus.—VI., VII. S. Kambara and M. Matsui (*Kōgyō Kwagaku Zasshi (J. Soc. Chem. Ind., Japan)*, 1933, 36, (4); *Brit. Chem. Abs.*, 1933, [A], 800).—[In Japanese, with English abstract in supplemental binding, pp. 134-137B.] (VI.—) A low-temperature thermostat electrically controlled for the range 0° to -60° C. is described. (VII.—) An air-bulb thermoregulator and a thermocouple control for an electric furnace are described.—S. G.

Pyrometric Economies. W. Bowen (*Ice and Cold Storage*, 1933, 36, 168).—See *Met. Abs.*, this volume, p. 200.—S. G.

XIII.—FOUNDRY PRACTICE AND APPLIANCES

(Continued from pp. 257-259.)

***Periodic Structures in Metals and Alloys.** L. Northcott (*Iron Steel Inst. Advance Copy*, 1934, (May), 1-9).—The banding effect which occurs in many steel ingots and castings is considered to be due to periodic crystallization. Similar structures have been prepared in a number of non-ferrous alloys, in which the periodicity was controlled by the casting conditions. It appears that the melt adjacent to the first batch of crystals undergoes both temperature and composition changes: an increase in temperature by virtue of the latent heat of solidification from the crystals, and an increase in the proportion of the lower melting-point constituents resulting in the lowering of the solidification temperature. Meanwhile the liquid further away from the solid eventually

starts to crystallize spontaneously and the effect is repeated. Supercooling is an essential factor without which crystal growth would be continuous, and the metal must probably reach the labile state for periodicity to occur, since growth from the metastable state is also continuous.—J. H. W.

Indications for the Melting of Aluminium Casting Alloys. — Irmann (*Aluminium Broadcast*, 1934, 4, (26), 2-6).—Translated from *Tech. Rundschau*, 1934, March 2. See *Met. Abs.*, this volume, p. 258.—J. C. C.

New Methods of Producing O.F.H.C. Copper. Anon. (*Indust. Bull. Arthur D. Little, Inc.*, 1934, (85), 2-3; *Bull. B.N.F.M.R.A.*, 1934, (62), 6).—O.F.H.C. copper has hitherto been prepared by melting cathode copper in the electric furnace under reducing conditions, and casting into vertical moulds in an oxygen-free atmosphere. Three other types of O.F.H.C. copper are now reported, produced (1) by deoxidation with phosphorus, so that the amount of phosphorus remaining is too small to be deleterious; (2) by careful deoxidation with lithium; (3) by forming solid homogeneous copper without melting, e.g. by sintering solid particles of cathode copper in a reducing atmosphere, followed by extrusion. No details are given.—S. G.

Cause and Effect in Bronze Founding. F. W. Rowe (*Proc. Inst. Brit. Found.*, 1932-1933, 26, 380-391).—See *J. Inst. Metals*, 1933, 53, 147.—S. G.

Some Factors Affecting the Soundness of Bronze Castings. E. J. L. Howard (*Proc. Inst. Brit. Found.*, 1932-1933, 26, 430-454).—See *J. Inst. Metals*, 1933, 53, 378.—S. G.

New Demands on the Brass Foundry. J. Arnott (*Proc. Inst. Brit. Found.*, 1932-1933, 26, 653-661; discussion, 661-666).—See *J. Inst. Metals*, 1933, 53, 378.—S. G.

Developments of Typefoundry Since 1720. H. Daniel Caslon (*J. Roy. Soc. Arts*, 1934, 82, 490-505).—A lecture.—E. S. H.

Advances in Die-Casting Technique. Ernst Proctorius (*Forschungen u. Fortschritte*, 1934, 10, 134-135).—A short review.—J. W.

Plaster Patterns in General Foundry Practice. R. Ballantine (*Proc. Inst. Brit. Found.*, 1932-1933, 26, 543-559; discussion, 560-565).—S. G.

Notes on Foundry Sands and Facings. F. A. W. Livermore (*Met. Ind. (Lond.)*, 1934, 44, 387-390).—Consideration is given to: composition, permeability and porosity, refractoriness, cohesiveness, and durability of moulding sand, the composition of core sand and the types of bonding materials used, the composition and treatment of parting sand and facing sand, and other materials used for facing.—J. H. W.

Routine Methods of Testing Green Sands. Sands and Refractories Subcommittee of the Technical Committee (*Proc. Inst. Brit. Found.*, 1932-1933, 26, 61-90; discussion, 90-103).—S. G.

Mechanized Foundries. F. J. Cook (*Proc. Inst. Brit. Found.*, 1932-1933, 26, 246-259; discussion, 260-268).—S. G.

Time Studies in Foundry Work. V. Bernard (*Proc. Inst. Brit. Found.*, 1932-1933, 26, 292-334).—French exchange paper.—S. G.

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

(Continued from p. 260.)

Separation of Copper from Complex Copper-Lead-Tin-Antimony Alloys. N. N. Muratch (*Zvetnye Metally (The Non-Ferrous Metals)*, 1933, (1), 99-100; *C. Abs.*, 1934, 28, 1636).—[In Russian.] Laboratory experiments showed that copper can be removed almost completely from complex copper-lead-antimony-tin alloys by melting with large amounts of lead oxide.—S. G.

XV.—FURNACES AND FUELS

(Continued from pp. 260–262.)

Heating by Producer Gas in the Structural Materials Industry. Joseph Deforge (*Rev. mat. constr. trav. publ.*, 1934, 19–20, 46–49, 79–83).—An explanation of the principle of the gas-producer is followed by an account of its development, with descriptions of certain modifications required by special types of practice. Causes of faulty performance are analyzed. A numerical instance illustrates the economy effected by utilizing pulverized fuels of poor quality. The working of the two-chamber type of transformer is described in some detail. The advantages of installing purifiers are emphasized; an example is shown in diagram, with an explanation of the theory of its working. A summarized account of modern industrial producers includes 3 main types, the special adaptations of which are described.—P. M. C. R.

The Problem of the Heat Recuperator. Arnold N. Lowan (*Phil. Mag.*, 1934, [vii], 17, 914–933).—A mathematical theory of the heat recuperator is developed, employing partial differential equations. The treatment is entirely mathematical.—J. S. G. T.

Automatic Regulation of Large Industrial Gas Furnaces. G. Wunsch (*Congrès du Chauffage Industriel* (Preprint), Group 4, Sect. 1, 1933, 6 pp.; *Bull. B.N.F.M.R.A.*, 1933, (60), 14).—Various methods for regulation of temperature and combustion are discussed.—S. G.

The Annealing of Wire. O. S. Haskell (*Heat-Treat. and Forging*, 1934, 20, 94–96).—The development of furnace equipment, the type of furnace and its operation, and the essentials for the good annealing of copper wire are discussed.

—J. H. W.

The Fundamental Formula for the Design of Electric Furnaces. Gorô Harada (*Kôgyô Kwagaku Zasshi* (*J. Soc. Chem. Ind. Japan*), 1933, 37, (1); *C. Abs.*, 1934, 28, 1929).—[In Japanese, with English abstract in supplemental binding, pp. 9–10.] A formula for the most favourable electrode diameter is developed on the assumption that $CV = \text{constant}$, where C is the current density in amp./cm.², and V is the actual voltage between electrode tip and top. This constant depends on the kind of material processed and the reaction temperature in the furnace; it is 355 for grey pig iron (1500°–1550° C.). The assumption does not hold for extreme cases. The formula is $r = \sqrt{KW} 1000/355 \times 3\pi$, where r is the electrode radius in cm. and KW is the furnace capacity in kw.—S. G.

†**Rocking Indirect Arc Electric Furnaces.** E. L. Crosby (*Elect. Engineering*, 1934, 53, 132–138).—An illustrated paper dealing with this type of furnace which is extensively used in brass and bronze foundries. It is claimed that the rocking action coupled with a non-oxidizing atmosphere and accurate temperature control results in the production of dense and homogeneous castings.—S. V. W.

Development of Metallurgical H.-F. Furnaces. M. Tama (*Z.V.d.I.*, 1933, 77, 199–202; *Sci. Abs.*, 1933, [B], 36, 354).—In general, the larger the furnace the lower is the frequency employed. For frequencies above 500~ the current generator is a homopolar machine, while for frequencies below 600~ a single-phase heteropolar construction is employed: typical machines of these types are described. The construction of the furnaces is described with particular reference to the water cooling of the coils and to the copper screening. The H.-F. condensers are constructed of paper and aluminium foil and are water-cooled. Finally, the coreless type of L.-F. furnace is discussed.—S. G.

Heating of Metals and Alloys by H.-F. Induction. E. F. Northrup (*Elect. World*, 1933, 101, 252–254; *Sci. Abs.*, 1933, [B], 36, 434).—For extremely fast

heating the induction process is unexcelled as the heat is generated inside the material itself instead of being imparted to it from without. To secure the best results the metal pieces should have a certain symmetry of form. Large diameters are better than small ones. Magnetic material is cheaper to heat than non-magnetic. The tonnage to be handled must be sufficient to justify the installation of a motor-driven generator to supply current at a frequency of 500 to 1000~, or, in special cases, 5000~.—S. G.

High-Frequency Induction Furnaces. C. A. Adams, J. C. Hodge, and N. H. Mackusick (*Elect. Engineering*, 1934, **53**, 194-205).—Gives a brief outline of the theory of induction furnaces and the application of the theory to the operating characteristics and limitations of such furnaces. From a metallurgical point of view the important features are freedom from contamination of the melt, high temperature obtainable, and circulation of the molten charge. There is a very extensive *bibliography*.—S. V. W.

***A Coreless Induction Furnace for Alternating Current of Ordinary Frequency.** Werner Hessenbruch and Wilhelm Rohn (*Stahl u. Eisen*, 1934, **54**, 77-82).—The construction and method of operating a coreless induction furnace with a capacity of 1.75 tons are described. The furnace is lined with powdered, fused magnesia, which sinters into a shell during the first melt. The cost of lining and the action of the current in promoting stirring of the charge are discussed. The furnace has been used for melting pure iron and for the refining of chromium-nickel steel.—J. W.

†**Electrical Equipment for Induction Furnaces.** C. C. Levy (*Elect. Engineering*, 1934, **53**, 43-48).—Frequency converters, switchgear, and condensers used in conjunction with induction furnaces are discussed and described. Particular reference is made to the advantages and possibilities of water-cooled equipment.—S. V. W.

Furnaces for High Temperatures, Especially for Ceramic Purposes, Melting, and Forging. H. Masukowitz (*Elektrowärme*, 1934, **4**, 15-18; *C. Abs.*, 1934, **28**, 1603).—Details of construction and operating data are given for furnaces which are equipped with a new design of heating unit as described by Junker (*Z. Metallkunde*, 1933, **25**, 38-42). This unit is like a ribbon with a reinforcing rib in the middle and permits an almost uniform surface heating of the walls and roof. A brass-melting furnace for a 100-kg. crucible, with 8-9 castings every 8 hrs., consumed only 300 kw.-hrs. per ton of brass when in continuous operation.—S. G.

Recent Developments in Electric Bright-Annealing Furnaces. —Tamele (*Elektrowärme*, 1934, **4**, 3-8; *C. Abs.*, 1934, **28**, 1605).—Box-type and continuous furnaces with and without protective atmosphere for the material are described, and details of construction are illustrated.—S. G.

The Electric Melting and Heat-Treatment of Iron and Steel. A. G. Robiette (*J. West Scotland Iron Steel Inst.*, 1933, **41**, 41-49, discussion, 49-52; and (abridged) *World Power*, 1934, **21**, 138-142).—The paper concludes with a brief reference to advances in non-ferrous practice.—S. V. W.

Industrial Electric Heating XX.—Forced Convection in Gases. N. R. Stansel (*Gen. Elect. Rev.*, 1933, **36**, 549-555).—The effect of velocity and the flexibility of its control, together with the penetrating property of gases, make forced convection in gases an effective method of heat transfer in many cases. The main limitation on this method of heating is the upper limit of about 650° C. at which fans can be operated although there are ways of overcoming this to a certain extent. The theoretical aspect of the subject is considered and then a number of forced convection resistance furnaces are described.

—S. V. W.

The Pyroptic Inspection Window. Anon. (*Glass*, 1933, **10**, 368).—A brief description of the "Mahon" inspection window for furnaces.—S. V. W.

XVI.—REFRACTORIES AND FURNACE MATERIALS

(Continued from pp. 262-263.)

†Recent Research in Special Refractories. E. Preston (*Glass Rev.*, 1933, 9, 101-105).—Reviews recent advances in the manufacture of highly refractory articles from pure alumina and magnesia and mixtures of the two oxides. A new refractory Siemensit with the composition 20-40% Cr₂O₃, 18-30% MgO, 25-40% Al₂O₃, and 8-14% residual matter, is also referred to. The fusion point of this refractory is stated to be greater than 2000° (C. ?).—S. V. W.

A Method for Decreasing the Porosity of Crucibles Made of Alumina. Tomo-o Satō (*Kinzoku no Kenkyū*, 1934, 11, 69-76).—[In Japanese, with English summary.] The porosity of alumina tubes and crucibles may be decreased by soaking them with saturated aqueous solutions of magnesium or aluminium chlorides or nitrates, drying and heating above 600° C. to produce magnesia or alumina in the pores. Crucibles treated in this way can be used in a Tammann furnace without fear of contaminating molten metal with carbon; they are also fairly resistant to the slagging action of cupric and ferrous oxides.—A. R. P.

Making High-Speed Calrod. C. H. Hannon (*Gen. Elect. Rev.*, 1933, 36, 409-410).—Briefly describes the production of fused magnesia used in "Calrod" heating units which consist of a Nichrome resistor, concentric with an outer metallic tube, with the magnesia insulation between them. Electrically fused magnesia, from specially selected calcined magnesia, has an insulation resistance, at 1000° C., six times that of the old grade. The specific resistance of the material is given as 11.4×10^6 ohms/in.³ at 1800° F. (982° C.). The power consumption is about 1.25 kw.hr per lb. of fused magnesia. The construction and application of the Calrod heater units is described in *Gen. Elect. Rev.*, 1933, 36, 354-360, 411-415 (following abstract).—S. V. W.

The Construction and Application of Calrod Heating Units. I.—The Calrod Unit. II.—Cartridge Units and Strip Heaters. R. M. Cherry and F. E. Finlayson (*Gen. Elect. Rev.*, 1933, 36, 354-360, 411-415).—(I.—) The Calrod type of heating element consists of a coiled nickel-chromium resistor insulated from the case by a dense mass of magnesia oxide. Of the numerous applications, the melting of soft metal such as tin, solder, and lead is one of the most important. Various forms are described. For the cast-in type cast-iron, aluminium, or copper may be used for the outer casting. Some actual furnaces using these units are illustrated, and certain particulars regarding this method of heating are given. (II.—) Describes a variation of the Calrod unit in which the coil of resistor is wound on a suitable former.—S. V. W.

Olivine as a Refractory. R. A. Heindl and W. L. Pendergast (*U.S. Bur. Stand. J. Research*, 1934, 12, 215-222; *Research Paper No. 645*).—Olivines representing 3 different deposits in North Carolina and 1 each in California, British Columbia, and Russia were tested to determine the possibilities of the material as a refractory. The chemical analyses were made on raw materials, and linear thermal expansion, sp. gr., P.C.E., and petrographic analyses determinations were carried out on both raw and heated materials. The results show that olivine from North Carolina apparently has the necessary properties demanded of a high-grade special refractory and that it might be used in industrial processes where possible contamination by iron is of no consideration.—S. G.

*The Thermal Expansion of Silica Bricks. Fritz Fromm (*Arch. Eisenhüttenwesen*, 1933-1934, 7, 381-384).—Five silica bricks of the same manufacture with d between 2.38 and 2.44 were tested for thermal expansion up to 1600° C. The expansion up to 1400° C. and the growth at 1400°-1600° C. due to the quartz transformation were greater the higher the d ; after heating at 1600° C. all the samples had $d = 2.32$. Specimens heated under pressure showed a

higher d owing to shrinkage of the pores. Conclusions on the behaviour of silica bricks in practical use are reached.—J. W.

***A Note on the Permeability of Refractory Materials to Gases.** A. Eric J. Vickers (*J. Soc. Glass Tech.*, 1933, 17, 93-101).—From measurements of the permeabilities and porosities of refractories, it is shown that the porosity measurements offer no guide to permeability except in such circumstances as are not likely to occur in commercial usage. An apparatus for measuring permeability at high temperatures is described, and the influence of temperatures has been measured in the case of some experimental refractories.—S. V. W.

***The Permeability of Refractory Materials to Gases.** I.—Experiments with Fireclay and Silica Products at Ordinary Temperatures. II.—Experiments with Fireclay and Silica Products at Temperatures up to 500° C. III.—Experiments at Temperatures up to 850° C. F. H. Clews and A. T. Green (*Trans. Ceram. Soc.*, 1933, 32, 295-318, 319-331; 1934, 33, 21-32).—(I.—) The literature on the subject is reviewed and the results are summarized. An apparatus is described for measuring the permeability of test-pieces 6 cm. in diameter. The rate of flow of air through a specimen is found to be directly proportional to the pressure difference up to 8 cm. of water, and probably beyond, and inversely proportional to the thickness, providing the pore spaces are uniformly distributed. The results of the permeability measurements for sixteen representative products in relation to their textures are considered and the uniformity of pore distribution in relation to a number of factors, is emphasized. (II.—) The permeability to nitrogen of eleven refractory materials has been directly measured at temperatures up to 500° C. As the temperature increases the permeability decreases in a manner almost independent of the nature of the material and the value of the permeability coeff. at ordinary temperatures. The decrease is accounted for, almost quantitatively, by the increase in the viscosity of the gas with increase in temperature. (III.—) The permeability to nitrogen of thirteen refractories between 500° and 850° C. has been measured. The results have followed the same general rules as those observed for temperatures up to 500° C. The reduction in permeability produced at 1000°-1350° C. has been calculated.—S. V. W.

†**Refractory Materials, Their Permeability to Gases.** E. Preston (*Glass Rev.*, 1934, 10, 10-13).—A brief consideration of the subject with particular reference to the work of Clews and Green, *Trans. Ceram. Soc.*, 1933, 32, 295-318, 319-331 (preceding abstract).—S. V. W.

***The Significance of Permeability to Gases in Relation to the Texture and Industrial Usage of Refractory Materials.** F. H. Clews and A. T. Green (*Trans. Ceram. Soc.*, 1934, 33, 56-72).—An attempt is made to illustrate the additional useful information that measurements of the permeability to gases can yield, in regard to the structure and texture of refractory materials. In particular, attention has been paid to the relation of the permeability of gases to the mechanism of corrosion in different types of industrial service.—S. V. W.

***The Action of Carbon Monoxide on Refractory Materials.** I.—Experiments on the Disintegration of Fireclay Products by Carbon Monoxide. II.—Further Experiments on the Disintegration of Fireclay Products by Carbon Monoxide. W. Hugill, H. Ellerton, and A. T. Green (*Trans. Ceram. Soc.*, 1933, 32, 533-542, 543-550).—(I.—) The literature is reviewed and an apparatus for studying the effect of carbon monoxide at 420° C. is described. There does not seem to be any direct relationship between the tendency to disintegrate and the amount of "iron" in the brick as determined by chemical analysis, although the amount of ferruginous matter which can be separated by bromoform appears to have some effect. (II.—) Tests for 200 hrs. at 420° C. on eleven fireclay products have been carried out. Only three resisted disintegration. The character of the iron compounds present is the most important factor influencing disintegration.—S. V. W.

†The Strength of Refractories at High Temperatures. E. Preston (*Glass Rev.*, 1933, 9, 129-134).—A brief review of existing information on the subject.—S. V. W.

†Further Notes on the Strength of Refractory Materials at High Temperatures. E. Preston (*Glass Rev.*, 1933, 9, 152-155).—A review of some fairly recent papers on the subject.—S. V. W.

*The Chemical Examination of Refractory Materials. IV.—Zirconiferous Bricks and Cements. H. J. van Royen and H. Grewe (*Arch. Eisenhüttenwesen*, 1933-1934, 7, 505-512).—The determination of zirconia is improved and simplified, and a new procedure for the complete analysis of zirconiferous refractories is given.—J. W.

*The Chemical Examination of Refractory Materials.—VI. The Determination of Alumina in Clays and Grog. H. J. van Royen and H. Grewe (*Arch. Eisenhüttenwesen*, 1933-1934, 7, 517-521).—A new rapid method for the determination of alumina and titania in clay and grog is described.—J. W.

*The Chemical Examination of Refractory Materials. V.—Carborundum and Carbon Bricks [and Graphite]. H. J. van Royen and H. Grewe (*Arch. Eisenhüttenwesen*, 1933-1934, 7, 513-516).—Standard procedures are recommended for the determination of carbon and of the water-absorptive power of graphite, and for the complete analysis of silicon carbide bricks, carbon bricks, and graphite. Examples are given.—J. W.

*The Calculation, From Their Physical Constants, of the Resistance of Refractories to Temperature Changes. K. Endell (*Glastech. Ber.*, 1933, 11, 178-182).—The resistance of refractories to temperature changes has been calculated by Norton's modified formula from the physical and mechanical constants. The results are in relatively close agreement with those obtained experimentally by determining the number of quenches from 950° C. in cold water which produce the first signs of cracking.—J. W.

Some Uses of Refractory Materials in the Foundry. J. G. A. Skerl (*Proc. Inst. Brit. Found.*, 1932-1933, 26, 566-592; discussion, 592-596).—See *J. Inst. Metals*, 1933, 53, 384.—S. G.

XVII.—HEAT-TREATMENT

(Continued from pp. 263-265.)

The Annealing of Duralumin Wire. S. D. Zypurdejew (*Metallurg (The Metallurgist)*, 1933, 8, (6), 50-52; *C. Abs.*, 1934, 28, 1640).—[In Russian.] The best results are obtained by heating to 370°-400° C. for 2-3 hrs., cooling in the furnace to 250°-70° C. and then cooling in air. This gives a tensile strength of 22-23 kg./cm.² and an elongation of 17-18%.—S. G.

*Influence of Thermal Treatment and Hardening on the Magnetic Properties of Copper-Nickel-Iron Alloys. I. Antik and B. G. Lifschitz (*Fisitscheski Zhurnal*, B, *Zhurnal tehnikeskoj Fiziki*, 1933, 3, 765-770; *Chem. Zentr.*, 1934, 105, I, 2033).—By annealing at 1200° C. instead of at 800° C. before tempering or hardening the homogeneity and grain size are increased, and thereby the permeability is improved and the coercivity reduced. Rapid cooling after hardening has the opposite effect, probably owing to the development of internal stresses.—A. R. P.

XVIII.—WORKING

(Continued from pp. 265-266.)

On Some Precautions for Avoiding Local Elements in the Working of Aluminium. H. Röhrig (*Korrosion u. Metallschutz*, 1933, 9, 332-334).—To prevent inclusions of small particles of foreign metals during rolling and

drawing of aluminium, it is recommended to pickle the sheet or wire in dilute caustic soda, rinse in water, dip in nitric acid, and again rinse; these operations should be done at one or more intermediate stages of the working. Removal of casting skins is also advisable, since most deleterious impurities tend to segregate towards the surface, there forming inclusions which encourage pitting under corrosive conditions.—A. R. P.

The Influence of Antimony and Bismuth on the Workability of Copper Bolts.

S. D. Zypurdejew (*Metallurg (The Metallurgist)*, 1931, (6), 875–882; *Chem. Zentr.*, 1934, 105, I, 2343–2344).—[In Russian.] Copper containing less than 0.1% antimony and 0.006% bismuth can be rolled hot to 7 mm., but with 0.01% of each of these metals fracture occurs. For hot-rolling to 53 mm. the upper limits of these impurities are 0.24% antimony (with less than 0.005% bismuth) and 0.01% bismuth (with less than 0.01% antimony). Similar limits hold for cold-rolling. Normal properties of 2 mm. wire are obtained only when both impurities are less than 0.005%.—A. R. P.

***Studies of the Wire-Drawing Process. IV.—Angle and Contour of the Die.**

E. L. Francis and F. C. Thompson (*Carnegie Schol. Mem., Iron Steel Inst.*, 1933, 22, 1–13).—With straight tapered dies, the best angle for most work is 6°; deviations from this angle in either direction sets up a greater frictional loss. Where the reduction is small, a smaller angle is necessary, especially with harder materials, in order to obtain the necessary length of bearing; but even in this case, the angle should be as near 6° as possible. With a rough, hot-rolled rod, where efficient lubrication is difficult, the angle may be 10°–11°, or, alternatively, a radial taper die, giving the necessary high angle of die when the metal first enters and decreasing to about 6° at the point of exit, may be used. It is probable that the parallel portion of the die at the exit end will entail the use of a higher tension, against which must be set off the increased life of the die before resetting. This work refers only to tungsten carbide dies, but the optimum conditions for steel dies are probably about the same. It appears that the die angle is not affected by the speed of drawing, the nature of the lubricant, or the carbon content of the steel, so long as the steel is not of the austenitic type. For the latter, a plain cone of 5°–5½° angle appears to be the best. The reduction of area has a small effect, 5½° being the best angle for a 35% reduction, and 6° for 20%. The work recorded was carried out on material of essentially one size; it does not follow that the ideal angle of die will be the same for all values of the original area. Cf. *J. Inst. Metals*, 1933, 53, 163.

—J. H. W.

***Studies of the Wire-Drawing Process. V.—Experiments with a Rotating Die (with Appendix: The Mechanical Properties of Wire Drawn Through Stationary and Rotating Dies).** E. L. Francis, H. Greenwood, and F. C. Thompson (*Carnegie Schol. Mem., Iron Steel Inst.*, 1933, 22, 15–30).—Linicus and Sachs (*Mitt. Material., Sonderheft* 16, 1931, 38) suggest that with rotating dies the drawing loads are lower than with still dies, owing to the smaller frictional loss. This was found to be the case only at low drawing speeds. At higher speeds, the loads become greater with the rotating dies, and L. and S.'s hypothesis must be abandoned. An alternative explanation is not put forward, but it is tentatively suggested that Lonsdale's work (*Phil. Mag.*, 1929, 8, 703; 1931, 11, 1169) on the elongation of wires under combined tension and torsion may have some bearing on the problem. In an appendix, the mechanical properties and recrystallization of wire drawn through stationary and rotating dies are compared, and it is concluded that there is very little, if any, difference in the mechanical properties, structure, recrystallization temperature, and rate of subsequent grain growth of wires drawn by the two methods, but the surface of wire drawn through rotating dies was in all cases more highly polished, and remained perfectly straight without any cast. Cf. preceding abstract.

—J. H. W.

***Studies of the Wire-Drawing Process. Via.**—Some Experiments Bearing on the "Casting" of Wire. A. S. Kenneford and F. C. Thompson (*Carnegie Schol. Mem., Iron Steel Inst.*, 1933, 22, 31-49).—"Casting" is overcome in the wire industry by tilting the die up to 5° , usually in two planes at right angles, by metal packing. This procedure, is, however, unreliable, and various data bearing on both the "casting" of wire and the effect of the internal stress which is always present are recorded. No constructive theory is put forward, but an examination of the effects of actual drawing on the curvature of the wire is submitted as a first step in elucidating the problem. Cf. preceding abstracts.—J. H. W.

A Note on the Effect of a Backward Pull Upon the Tension Required to Draw Wire. F. C. Thompson (*J. Iron and Steel Inst.*, 1933, 128, 369-373; discussion, 374-382).—For abstract of the paper see *J. Inst. Metals*, 1933, 53, 667. In the discussion in which J. Dick and K. B. Lewis took part, and to which F. C. T. replied, attempts have been made to analyze mathematically the forces involved in wire-drawing and to advance a theoretical explanation of the observed phenomena.—A. R. P.

The Drawing of Zinc Sheet. Anon. (*Illust. Z. Blechindustrie*, 1934, 63, 408-409).—Suitable compositions are indicated for zinc intended for deep-drawing. The cadmium content should not exceed 0.5%. According to the treatment of the material subsequent to drawing, optimum diameter ratios are given for drawing rings and blanks. Appropriate materials are suggested for rings, the preparation of which is described, with precautions intended to obviate certain defects in the finished pieces.—P. M. C. R.

Research on Machining Expedites Work. W. Leyensetter (*Maschinenbau*, 1932, 11, 221-223).—Modern machining practice demands, on economic grounds, an increasing use of light rather than heavy cutting, and investigation on machinability, wear, waste, and surface finish becomes necessary, the results obtained using heavy cuts being inapplicable to light-cutting practice. The significance and derivation of the "cutting coefficient" are discussed. The application of the pendulum process to investigations of wear and machinability is described.—P. M. C. R.

***Diamond-Impregnated Carboloy.** George F. Taylor (*Gen. Elect. Rev.*, 1934, 37, 97-99).—Describes an interesting development in the manufacture of hard cutting tools in which diamond is embedded in Carboloy. Even in tools, such as wire-drawing dies, it is advisable to set the single stone in Carboloy because the coeff. of expansion of the two are very close together, and the good thermal contact obtained results in a greater dissipation of the heat generated when the tools are in use. At present diamond-impregnated Carboloy is used principally for dressing emery wheels. The method of manufacture and certain other applications are briefly described. [*Note*: Carboloy is the American counterpart of Widia.]—S. V. W.

XIX.—CLEANING AND FINISHING

(Continued from p. 266.)

Metal Finishes Used in Modern Architecture. S. Wernick (*Metallurgia*, 1934, 9, 191-192).—The basic principles underlying metal finishing and the value of various finishes as regards durability and general efficiency of a structure are discussed. The processes discussed in considering these principles are Sherardizing, Calorizing, chromizing, spraying, and anodic oxidation, and it is stated that in the future anodizing will be one of the most useful adjuncts to the architect and builder who wishes to make use of aluminium for constructional purposes.—J. W. D.

Baked Finishes on Die-Castings. C. F. Scribner (*Indust. Finishing*, 1934, 10, (4), 39-40; *C. Abs.*, 1934, 28, 2550).—Practical suggestions for obtaining better finished products are given.—S. G.

XX.—JOINING

(Continued from pp. 266-263.)

Light Metal Rivets.—II.—III. K. Guler (*Z. Metallkunde*, 1934, 26, 65-67, 90-91).—Cf. *J. Inst. Metals*, 1933, 53, 669. (II.—) Tolerances for the dimensions of the riveting wire, rivet, and boring for various types of rivets are tabulated and some practical hints are given. (III.—) Directions are given for the determination of the shear strength, tensile properties, hardness, and compressibility of riveting wire of age-hardenable aluminium alloys, e.g. Avional.—M. H.

†High-Strength Light Alloy Rivets. Anon. (*Metallurgist* (Suppt. to *Engineer*), 1934, 10, 108-110).—A summary and critical discussion of papers by G. W. Akimov, *Korrosion u. Metallschutz*, 1932, 8, 309-313 (see *J. Inst. Metals*, 1933, 53, 355), and by M. Abraham, *Z. Metallkunde*, 1933, 25, 203-206 (see *J. Inst. Metals*, 1933, 53, 695).—R. G.

***Soldering, Brazing, and Autogenous Soldering.** C. V. Boys (*J. Sci. Instruments*, 1934, 11, 105-111).—A general article, describing practical methods of soldering, brazing, and welding (lead burning) developed by the author for different purposes, chiefly connected with the construction of instruments. Soft soldering, fluxes, sweating, brazing, silver-soldering, and lead burning are dealt with, and also the design of instruments where soldered joints are required.—W. H. R.

On the Proper Use of Certain Soft-Soldering Alloys. Anon. (*Illust. Z. Blechindustrie*, 1934, 63, 409-410).—The selection of a solder is influenced not only by its setting properties, but also by its tendency to form compounds with the basis metal, by its strength, and in some cases by its electrical conductivity. Suitable compositions are recommended for general purposes, for high tensile strength, and for electrical work: in each case variations are indicated for different basis materials. The importance of proper cleaning and of selecting a suitable flux is emphasized.—P. M. C. R.

Cadmium-Zinc Solder. — ((*British*) *Air Min. Specification* No. D.T.D. 221, 1933, 1 p.).—S. G.

Recent Experience in Welding Duralumin. Anon. (*Illust. Z. Blechindustrie*, 1934, 63, 408).—Gas welding is preferred to electrical welding on account of the high working temperature involved in using the latter: intense local heating without burning can be effected by proper adjustment of the flame. Details as to flux and flame control are given for the oxy-acetylene welding of thick Duralumin sheet.—P. M. C. R.

Five Per Cent. Magnesium-Alloy Welding Rods and Wire. — ((*British*) *Air Min. Provisional General Specification* No. D.T.D. 202, 1932, 1 p.).—Covers the material generally known as "MG 5" alloy, which is suitable for welding "MG 7" alloy. The sp. gr. of this alloy is between 2.63 and 2.7.—S. G.

Welding of Lead. Ch. Schlingmann (*Maschinenbau*, 1933, 12, 299-300; and (abstract) *Z. Metallkunde*, 1934, 26, 93).—The rate of production of butt-welded and welded spigotted joints in lead tubes of different diameters is tabulated as a base for the calculation of welding costs.—M. H.

The Welding of Monel Metal and Nickel. Anon. (*Welding Ind.*, 1934, 1, 369-371; 2, 84-86).—For oxy-acetylene welding, the great importance of accurate flame control is emphasized. A slightly reducing flame is recommended. The best flux is considered to be powdered boric acid, which may be sprinkled on the part to be welded or made into a saturated solution in alcohol. Sheets thinner than 18 G. are butt-welded without filler rod by flanging the edges. The edges of thicker sheets should be chamfered at 45° C. and welded

with a filler rod of diameter equal to the thickness. For metallic arc welding, covered electrodes of diameter slightly greater than the thickness of the sheet, are recommended. These should be connected to the positive pole of the generator. Tacking at not more than 6 in. pitch is essential. Spot and seam welding present no difficulties. Welds in Monel metal and pure nickel are said to have almost as great corrosion-resistance as the parent metal.—H. W. G. H.

Concerning the Strength of Welded Joints, Especially the Dependence of Strength on the Form [of Joint]. Otto Graf (*Autogene Metallbearbeitung*, 1934, 27, 1-12; discussion, 17-22).—The use of the tensile test, the information it gives, and the characteristics of a typical load-extension diagram are discussed. The importance of the plasticity of a material is explained; it is pointed out that stress concentration in a drilled tensile test-piece causes it, when made of brittle material, to fail at a lower stress, calculated on the reduced area, than does a solid test-piece of the same area. Moreover, a ductile material fractures in a "brittle" manner under repeated stressing so that drilled test-pieces have lower fatigue strength than solid specimens of equivalent area. In the investigation of welded joints, fatigue tests give more useful information than the tensile test. For example, "undercut" in arc welds produces stress concentration which lowers the fatigue strength, although little effect can be noticed on the tensile strength. Incomplete penetration and flaws have similar effect. The more even distribution of stress, produced by inclining the weld to the direction of stressing, is found to be an advantage. The possibility of imperfections even in welds produced under the best conditions led to the use of straps welded across butt-joints. Although these reduce the deformation and static stress which may occur in the butt-weld, it is found that stress concentration occurs at the ends of the straps, with little effect on the tensile, but serious effect on the fatigue strength. The use of these straps is therefore considered unnecessary except as a support for poor butt-welds. Various designs are reviewed, their object being to reduce the stress concentration. In the discussion, *Hoeffgen* described tests on joints between steel plates made by two straps on opposite sides, sandwich fashion, secured by fillet welds parallel to the straining axis of the test-piece, the stress thus being transmitted through four fillet welds on each side of the joint. It was found that higher tensile strengths were obtained with short than with long fillet welds. *H.* considers that the latter impede plastic flow of the parent material and consequently cause uneven stress distribution. *G. Bierett* discussed the effect of raising the mean stress in fatigue testing welded joints (in steel) of various designs.

—H. W. G. H.

Stress Distribution in, and Strength of, Fillet-Welded Joints. *G. Bierett* and *G. Gruning* (*Elektroschweissung*, 1934, 5, 33-34).—The stress distribution in a butt-cross joint and two strapped joints, one having 45° fillets and the other 30° fillets, was investigated by elongation measurements in test-pieces cut out of solid sheet to the shape of the welded joints. In this way, the effects of heterogeneity of the material were eliminated. Fatigue tests were also made on similar "solid" specimens, and these confirmed the conclusions reached from the stress-distribution experiments. It was found that the fatigue-strength of one of these specimens was no greater than that of the corresponding welded joint.—H. W. G. H.

The Control of Autogenous Welding. Anon. (*Machine moderne*, 1934, 38, 115).—Cf. *Met. Abs.*, this volume, p. 210. The findings of the Committee on Welding Technique appointed by the Verein Deutscher Ingenieure are considered and criticized.—P. M. C. R.

Physical Side of Electric Arc Welding. *E. Westman* (*A.S.E.A. Journal (Allmänna Svenska Elektriska A.B.)*, 1932, 9, 158-160; *Sci. Abs.*, 1933, [B], 36, 146).—The inter-electrode gaseous conditions which exist during the formation of an arc are discussed and the behaviour of the arc when the anodes and cathode are relatively displaced is illustrated. Oscillograms show the ad-

vantage of the inductive welding circuit over the non-inductive method with regard to the stability of the arc produced.—S. G.

Atomic-Physical Bases for the Phenomena of the Welding Arc. H. v. Conrady (*Elektroschweißung*, 1934, 5, 21-25).—The electronic structure of the atom is briefly described with particular reference to its behaviour in the electric arc. The zones existing in a d.c. arc are explained and a theory is suggested to account for the transfer of metal in the welding arc, especially in the case of overhead welding, for which the "pinch effect" theory is considered inadequate.—H. W. G. H.

Atomic Arc Welding and Its Applications. J. A. Dorrat (*Metropolitan-Vickers Gazette*, 1933, 14, 100-110).—Cf. *Met. Abs.*, this volume, p. 43.—S. G.

The Performance Diagram of Acetylene Apparatus. Gottfried Lottner (*Autogene Metallbearbeitung*, 1934, 27, 49-54).—An apparatus is described for testing the load-capacity of acetylene generators. These are classified into various types, according to the method of gasification and the kind of gas-holder; an example of each type is illustrated diagrammatically and its performance under load is shown by curves giving the pressure in the gasification chamber, the gasholder, and the burner tube, during the gasification of a charge and under a constant load.—H. W. G. H.

[Contribution to] **the Question of Testing Injector Blowpipes.** E. Streb and H. Kemper (*Autogene Metallbearbeitung*, 1934, 27, 54-58).—It is pointed out that heating of the nozzle during welding causes an alteration in the proportion of oxygen to acetylene flowing through an injector blowpipe. The maximum variation which can be permitted without detrimental effect on the quality or economy of welding is considered to be from 1:1 to 1.2:1. Previous researches on the subject are criticized. A testing apparatus is described by which the effect of increase of pressure at the burner nozzle and the acetylene pipe-line pressure can be observed. It is found that the influence of nozzle temperature on gas ratio is reduced by increase in pressure of acetylene.

—H. W. G. H.

Gas Ratio and Shape of Flame of an Injector Blowpipe with Varying Acetylene Pressure in the Supply Pipe. Eduard Sauerbrei (*Autogene Metallbearbeitung*, 1934, 27, 59-62).—The supply from an acetylene generator is rarely at constant pressure. An apparatus is described for determining the effect of variations on the proportion of oxygen to acetylene in the flame and the resultant form of the latter. It is found that pressure variations in the acetylene supply have less effect as the average acetylene pressure is increased. Pressures in the injector chamber and at the nozzle are found to be independent of the acetylene supply pressure, and are always the same for a given gas ratio and flame form. The acetylene supply pressure is measured before the control valve of the blowpipe.—H. W. G. H.

XXI.—INDUSTRIAL USES AND APPLICATIONS

(Continued from pp. 269-274.)

Aluminium Castings for Tramcar Bodies. E. R. L. FitzPayne (*Modern Transport*, 1934, 31, (785), 12).—The specification is quoted for the material of light-alloy body castings used in a tramcar which has been in satisfactory service in Edinburgh for 2 years. A table gives the variation in properties of the sand-cast, and in 2 cases, the chill-cast alloy as supplied by 6 tendering firms, together with the cost per lb. The chemical analysis of the alloy chosen was: silicon 11.5-12.3, manganese 0.3-0.5, magnesium 0.4-0.6, iron less than 0.5, other metals less than 0.1%, remainder aluminium.—P. M. C. R.

Development of Modern Passenger Coaches on the German State Railway. —Stroebe and —Wiens (*Organ Fortsch. Eisenbahnwesens*, 1932, 87, (2/3), 4-40).—Coaches for use on urban lines utilize Lantal, Skleron, and Silumin wherever possible, steel being employed only for the most heavily stressed

members. The concomitant variations in design are discussed, and the mechanical problems involved in the adoption of light alloy construction are summarized.—P. M. C. R.

Ten Years' Use of Aluminium Light Alloys in American Railroad and Tramway Construction. — Theobald (*Glazers Ann.*, 1934, 114, 21–22).—J. W.

Heavy Bridge Floor Replaced with Aluminium. J. P. Growdon, Ross M. Riegel, and R. L. Templin (*Civil Eng.*, 1934, 4, 113–117).—The steel and wood floor of Smithfield Street Bridge, a 50-year-old bridge in Pittsburgh, Pa., U.S.A., was replaced with 340 tons of aluminium alloy, reducing the dead load by more than 1 ton per lineal foot, and extending the estimated useful life of the bridge by 25 years. A battle-deck floor was designed on the basis of measurements on test-panels under H-20 loading, checked by service tests. Heat-treated "17 ST" alloy was used for the floor, "4 SH" alloy for the top rail and balusters, and "53 ST" alloy for the bottom rail and posts. Painting is not necessary.—J. C. C.

The Grid at Work [Aluminium Conductors]. J. D. Peattie (*Electrician*, 1933, 110, 546–547; *Sci. Abs.*, 1933, [B], 36, 514).—Outlines experience in operation and maintenance over a period of 4 years since the first 132 kv. line was put into service. Tests on steel-covered aluminium conductors removed from lines show that no appreciable mechanical or electrical deterioration has taken place. Even in industrial atmospheres the dark deposit which quickly forms over the strands provides a good protective coating. Conductor joints both of Continental and British design have proved thoroughly reliable, except for a small number made of an aluminium-zinc alloy which became unstable. The latter have been replaced by others of aluminium-magnesium alloy or of pure aluminium.—S. G.

Some Experiences in the Use of Aldrey for Overhead Conductors. Maurice Thomas (*Conférence internat. des Grands Réseaux électriques à haute tension*, (Preprint), 1933, (June), 15 pp.).—See *Met. Abs.*, this volume, p. 215.—S. G.

Aluminium Round Seamless Tubing. — (*U.S. Federal Specifications Board, Federal Specification No. WW-T-783*, 1933, 10 pp.).—S. G.

Half-Hard Aluminium Alloy Sheets and Strips. — (*British Air Min. Specification No. D.T.D. 209*, 1933, 3 pp.).—Covers the aluminium alloys containing in each case not more than magnesium 3.0, manganese 1.5, iron 0.75, and silicon 0.75%, and having a sp. gr. of 2.70.—S. G.

Aluminium Alloy (Aluminium-Copper-Magnesium-Manganese) Bars, Rods, Shapes, and Wire. — (*U.S. Federal Specifications Board, Federal Specification No. QQ-A-351*, 1933, 10 pp.).—S. G.

Aluminium Alloy (Aluminium-Copper-Magnesium-Manganese) Plates and Sheets. — (*U.S. Federal Specifications Board, Federal Specification No. QQ-A-353*, 1933, 9 pp.).—S. G.

Aluminium-Manganese Alloy Sheets and Strips. — (*British Air Min. Specification No. D.T.D. 213*, 1933, 3 pp.).—Deals with the aluminium alloy containing not more than manganese 1.5, iron 0.75, silicon 0.6, and copper 0.15%, and having a sp. gr. of 2.70.—S. G.

Aluminium Alloy (Aluminium-Manganese) Bars, Rods, Shapes, and Wire. — (*U.S. Federal Specifications Board, Federal Specification No. QQ-A-356*, 1933, 10 pp.).—S. G.

Aluminium-Magnesium Alloy Castings [Birmabright]. — (*British Air Min. Specification No. D.T.D. 165*, 1933, 3 pp.).—Covers the alloy generally known as Birmabright, sp. gr. 2.68.—S. G.

10% Silicon-Aluminium Alloy Castings. — (*British Air Min. Specification No. D.T.D. 231*, 1934, 3 pp.).—Covers the material generally known as "M.V.C." alloy.—S. G.

Aluminium Foil for Insulating Purposes. G. P. Crowden (*Lancet*, 1934, Jan. 6; *Bull. B.N.F.M.R.A.*, 1934, (65), 3).—Reinforced aluminium foil (asbestos, &c., covered on both sides by aluminium foil) fixed so as to divide the air space

across which transference of heat tends to take place, has been found to have good insulating properties. This is illustrated by laboratory experiments and by service tests in Egypt in huts, tents, trains, and ambulances, and with food-containers and tropical helmets, as well as on board ship.—S. G.

Aluminium Powders and Aluminium Paints. Franz Friedrich (*Metallbörse*, 1934, 24, 162–163, 194–195).—A survey of the methods of production, properties, and uses of these products.—A. R. F.

Beryllium Alloys in Watchmaking. André Donat (*Machine moderne*, 1933, 27, 574–575).—The alloys of copper with up to 3% beryllium possess high tensile strength and elasticity, considerable hardness and incorrodibility, and are non-magnetic. Their possible applications as watch and clock parts are enumerated. The hardening of Elinvar by the addition of beryllium produces a non-magnetic alloy (Nivarox) possessing superior mechanical and thermal properties to those of Elinvar, and hence a valuable material for springs.

—P. M. C. R.

Tentative Standards for Copper in Semi-Finished Products. Outline 1 for DIN E 1787. German Committee for the Standardization of Non-Ferrous Metals (*Z. Metallkunde*, 1934, 26, 94).—Copper for sheets, tubes, &c.: copper at least 99.4%, oxygen, not more than 0.1%. Copper for firebox plates, stays, &c.: copper at least 99.0%, arsenic, arsenic + nickel, and oxygen, not more than 0.50%, 1.0%, and 0.1%, respectively. In both cases the content of antimony, selenium + tellurium, bismuth, sulphur, and aluminium should not be more than 0.08%, 0.01%, 0.01%, 0.05%, and 0.01%, respectively.—M. H.

Aluminium-Bronze Die-Castings. — ((*British Air Min. Specification* No. D.T.D. 174, 1933, 2 pp.).—S. G.

Aluminium-Nickel-Iron Bronze Bars, Stampings, and Forgings. — ((*British Provisional Air Min. Specification* No. D.T.D. 197, 1932, 3 pp.).—Covers the alloy generally known as "Superston L. 189 bronze."—S. G.

Cadmium-Copper Alloy Wires and Strips. — ((*British Air Min. Specification* No. D.T.D. 208, 1933, 3 pp.).—S. G.

Lead-Bronze Ingots and Bars (Suitable for Bearings). — ((*British Air Min. Specification* No. D.T.D. 229, 1934, 1 p.).—S. G.

Hard-Drawn Phosphor-Bronze Bars. — ((*British Air Min. Specification* No. D.T.D. 78A, 1933, 3 pp.).—Supersedes specification No. D.T.D. 78.—S. G.

Hard-Drawn Phosphor-Bronze Tubes. — ((*British Air Min. Specification* No. 79A, 1933, 2 pp.).—Supersedes specification No. D.T.D. 79.—S. G.

Design and Manufacture of Telephone Cables. F. H. Buckland and R. H. Franklin (*Inst. Post Office Elect. Eng. Paper* No. 144, 1933, 1–52; *Sci. Abs.*, 1933, [B], 36, 526).—The paper is divided into two parts, design, and manufacture. The second part deals among other matters with wire-drawing, materials, and lead-covering.—S. G.

Cadmium Alloy Ingots (Suitable for Bearings). — ((*British Air Min. Specification* No. D.T.D. 217, 1933, 1 p.).—S. G.

Marking of Gold-Filled and Rolled-Gold Plate Articles other than Watchcases. (U.S. Dept. Commerce, *Bur. Stand., Commercial Standard* CS 47–34, 1934, 1–10).—The standard of rolled-gold or gold-filled demands that the gold coating of the article shall be at least 10-carat, and that the proportion by weight of this coating shall be marked on the article, thus 1/10–12 k. gold-filled implies that the base metal is covered on one or more surfaces with a gold alloy of 12-carat fineness, and that the coating comprises one-tenth of the total weight of the article.—A. R. P.

Manufacture and Technique of E.H.T. Cables. M. Ding (*Bull. Soc. belge Elect.*, 1933, 49, 105–127; *Sci. Abs.*, 1933, [B], 36, 332).—Progress made during the past 20 years is summarized. Consideration is given to materials of construction—sheath, armouring, and dielectric. The characteristics of the 3-core Hochstädter, and 1-core cable are discussed, and losses in sheaths and armour-

ing of l-core cables are tabulated. Methods of bonding sheaths to reduce sheath losses are described.—S. G.

White Metal Ingots (Suitable for Bearings). — ((*British Air Min. Specification No. D.T.D. 214*, 1933, 1 p.).—S. G.

Magnesium Alloy Sheets (not Suitable for Welding). — ((*British Air Min. Specification No. D.T.D. 120*, 1933, 2 pp.).—S. G.

Magnesium Alloy Bars. — ((*British Air Min. Specification No. D.T.D. 127*, 1932, 2 pp.).—S. G.

Heat-Resisting Alloys [Kanthal]. J. H. Russell (*Elect. Times*, 1933, **84**, 183–184; *Sci. Abs.*, 1933, [B], **36**, 627).—Refers particularly to the use of the new aluminium–chromium–cobalt–iron alloys, known as Kanthal, in the manufacture of heating elements for electric fires. These alloys, it is stated, possess decided advantages over the old 80 : 20 nickel–chromium alloys. There are 3 types of Kanthal—Al, A, and D. Of these Kanthal D is the best for electric fires.—S. G.

High Nickel–Copper Alloy Sheets [Monel Metal]. — ((*British Air Min. Specification No. D.T.D. 10B*, 1933, 2 pp.).—Supersedes specification No. D.T.D. 10A.—S. G.

High Nickel–Copper Alloy Hot-Rolled or Forged Bars, Stampings and Forgings [Monel Metal]. — ((*British Provisional Air Min. Specification No. D.T.D. 192*, 1932, 3 pp.).—S. G.

Cold-Rolled or Cold-Drawn and Annealed High Nickel–Copper Alloy Bars (Suitable for Cold-Bending) [Monel Metal]. — ((*British Provisional Air Min. Specification No. D.T.D. 196*, 1932, 3 pp.).—S. G.

Hard-Drawn High Nickel–Copper Alloy Bars [Monel Metal]. — ((*British Provisional Air Min. Specification No. D.T.D. 200*, 1932, 3 pp.).—S. G.

High Nickel–Copper Alloy Rods, Wire and Rivets [Monel Metal]. — ((*British Air Min. Provisional Specification No. D.T.D. 204*, 1932, 2 pp.).—S. G.

Application of Nickel–Iron Alloys to Modern Current Transformers. B. Hague (*Elektrotech. u. Masch.*, 1933, **51**, 208–211; *Sci. Abs.*, 1933, [B], **36**, 510).—Although silicon steel has low losses and a high permeability at low inductions, its exciting ampère-turns are sufficiently large to cause considerable ratio and phase-angle errors. With a corresponding size of nickel–iron core transformers, however, the necessary lines of force can be obtained with only $\frac{1}{10}$ to $\frac{1}{50}$ of the ampère-turns, with a corresponding reduction of these errors. The 50% nickel–iron alloy developed for current transformers is known as Hipernik and has a maximum permeability of 70,000 and an initial permeability of 3000: the hysteresis loss at 10,000 gauss is 220 ergs/cm.³/cycle and the resistance is 46 microhms/cm.³ at 20° C. Alloys with about 78% nickel are known as Permalloys, the most important of which is Mumetal, which is an alloy of nickel 76, iron 17, copper 5, and chromium or manganese 2%. The highest permeability is from 45,000 to 100,000 and initial permeability from 12,000 to 30,000; the total iron loss at 5000 gauss and 50 ~ is 0.1 watt/kg. and the resistance is 43 microhms/cm.³.—S. G.

Silvering of Mirror Surfaces by Cathode Sputtering. M. Romanova, A. Rubcov, and G. Pokrovskii (*Dokladi Akademii Nauk U.S.S.R. (Compt. rend. Acad. sci. U.S.S.R.)*, 1934, **1**, 15–16 (in Russian); 17–18 (in German); *C. Abs.*, 1934, **28**, 2277).—Silvering was carried out in a hydrogen atmosphere of 0.05 mm. with a current of 15–20 ma., and a potential of 1400 v. Mirrors obtained had a reflectivity of 98% (normal–93%) only very slowly decreasing. Partly transparent mirrors absorbed less than 1% of incident light.—S. G.

The Féry–Carbone Dry Tin Accumulator. C. J. V. Féry (*Tech. Publ. Internat. Tin Research and Development Council*, 1934, [C], (1), 1–5).—The accumulator described uses electrodes of tin and lead peroxide, respectively, in sulphuric acid as electrolyte, which is rendered immobile by packing with acid-resistant, finely-divided ceramic material. The cell is capable of giving an

e.m.f. of 1.9 v.; during discharge the horizontal occurs at 1.75 v. and the final drop at 1.60 v. The tin electrode has the advantage that no gas is evolved during discharge or storage. The cell is also lighter than a lead accumulator of similar capacity, has a low internal resistance, and can be kept in an inverted or other position.—E. S. H.

The Hard Metals. W. Guertler (*Glasers Ann.*, 1933, 113, 105–106).—A short review.—J. W.

Metallization of Surfaces Other than Glass and Metal. — (*Sci. Library (Lond.) Biblio. Series No. 123*, 1934, 3 pp.).—A list of references to the literature and patents published since 1915.—S. G.

Selection of Service Pipe Material Under Present Prices. Walter A. Peirce (*J. Amer. Waterworks Assoc.*, 1933, 25, 1653–1656).—Returns made in 1933 from 65 municipal and 14 private American and Canadian water supply plants giving the materials used for service pipes are tabulated, together with prices of copper tubing from 1929 to 1933. Changes in cost have had little effect on the choice of materials.—J. C. C.

XXII.—MISCELLANEOUS

(Continued from pp. 274–275.)

Aluminium in Great Britain. Method of Production and Uses. George Boex (*Times Trade and Eng. Suppl.*, 1934, 33, (813), 451).—A useful summary giving facts and figures relating to the various stages in the production of aluminium from bauxite. The world's production of this metal has increased from 5000 tons (estimated) in 1900 to approx. 260,000 tons in 1930.—S. V. W.

***Cementation Tests with Various Metal Carbides.** Jwan Gaefl (*Arch. Eisenhüttenwesen*, 1933–1934, 7, 587–588).—Cementation tests with the carbides of iron, manganese, tungsten, and chromium have shown that diffusion of these into mild steel starts only above their dissociation temperatures.—J. W.

Technique of a Thousand Years Ago. A Glance Through the *Diversarum Artium Schemata* of Theophilus Presbyter. W. Theobald (*Glasers Ann.*, 1933, 113, 81–86, 99–105).—A selection from T.'s book ("Technik des Kunsthandwerks im zehnten Jahrhundert," Berlin, 1933). Of especial interest is the section on the recovery of metals and the technique of moulding and casting a thousand years ago.—J. W.

Some Aspects of the Selection of Engineering Materials. L. B. Hunt (*Proc. Inst. Brit. Found.*, 1932–1933, 26, 479–500).—See *J. Inst. Metals*, 1933, 53, 475.—S. G.

Industrial Economy Suggestions. Glyn Powis (*Metallurgia*, 1934, 9, 181–182).—Gives typical examples of industrial circumstances where careful consideration, coupled with wise expenditure, can result in appreciable savings. Among the points dealt with are furnace insulation; the use of improved steels for dies and tools, and of special heat-resisting non-corroding steels for hardening and annealing plant, pyrometer sheaths, and high-temperature furnace metal work; the question of machinery and outlay of plant; production costs, and laboratory control.—J. W. D.

The Control of Industrial Research. Metropolitan Life Insurance Co. (U.S.A.) (*Metropolitan Life Insurance Co. (U.S.A.) Policyholders Service Bureau, Pamphlet No. B-271*, 1934, 30 pp.; *Bull. B.N.F.M.R.A.*, 1934, (65), 20).—A report based on a study of methods used by 45 American industrial organizations in controlling the activities of research and development departments. The data are set out under the following headings: organization of research department; origin and authorization of research projects; preparation of cost estimates; the research budget; standardized research procedure; cost keeping and control; review and reconsideration of research projects.—S. G.

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XXIV.—BOOK REVIEWS

(Continued from pp. 281-284.)

La Crystallisation des Métaux. Par N. T. Belaiew. Conférences de Métallurgie faites à l'École Royale des Mines, Collège Imperial, sous les auspices de l'Université de Londres. Traduit de l'anglais par G. R. Delbart. Revu et mis à jour par N. T. Belaiew avec la collaboration de Mlle. L. Bloch-Sée. Preface de Henry Le Chatelier. Demy 8vo. Pp. 128, with 75 illustrations. 1934. Paris: Institut de Soudure Autogène, 32 Boulevard de la Chapelle. (20 francs.)

This is a translation into French of a book first published in English, and based on a series of lectures delivered in 1922 (see *J. Inst. Metals*, 1923, 29, 839). Whilst the matter remains in general identical with the original edition, the bibliographical references have been brought more nearly up to date. The book has been reproduced in excellent fashion, both as regards text, illustrations, and diagrams.—W. A. C. NEWMAN.

Ausschuss in der Metallgiesserei. Ursachen und Beseitigungen. Von Max Schied. Med. 8vo. Pp. 91, with 41 illustrations. 1933. Berlin: Otto Ellsner Verlagsgesellschaft m.b.H. (Geb., R.M. 4.50.)

This small volume deals with the causes for, and prevention of, waste and scrap in foundries. It is divided into four sections dealing respectively with common errors that are made in: (1) casting in green-sand moulds; (2) casting in dry-sand moulds; (3) cover manufacture; and (4) general foundry melting. The arrangement is unusual. In each division mistakes that are frequently the cause of inferior work are dealt with individually. Their evidences, their causes, and finally the remedies are given in turn. It cannot be said, of course, that every contingency has been provided for, but the essentially practical details that are given should prove extremely useful to the foundryman in identifying faults and curing them.—W. A. C. NEWMAN.

The Casting of Brass Ingots. By R. Genders and G. L. Bailey. With an Introduction by H. Moore. (British Non-Ferrous Metals Research Association, Research Monograph No. 3.) Roy. 8vo. Pp. xv + 191, with 123 illustrations. 1934. London: British Non-Ferrous Metals Research Association, Regnart Buildings, Regnart St., N.W.1. (15s.; 15s. 6d. post free.)

This volume is a comprehensive summary of the work undertaken by the British Non-Ferrous Metals Research Association on casting methods and of the conclusions reached by those who were entrusted with the task. Much of the detail which is here omitted has been published in earlier reports. The work done has centred mainly round the casting of 70 : 30 brass, as this is the material most commonly used for strip. Thus the actual field of investigation has been rather circumscribed. The principles under examination, however, and the general deductions, are relevant to other industries using different alloys.

At the outset a brief historical digest of brass ingot casting, and of the conditions that existed when the major research was started is given. Collaterally with the progress of this research, other striking developments have occurred, e.g. in electric furnace melting, water-cooled moulds, vacuum melting, &c., which are also considered.

The correct relationships between the mould and the molten metal constitute the first portion of the preliminary investigation, and embrace mould size, surface perfection, structure, and composition, contraction, sub-surface and other minute cavities, density determinations for detecting unsoundness, and non-metallic inclusions. The second part of the preliminary examination is concerned with common surface defects in strip and the correlation of ingot properties with those of the strip. In each case a close study of typical instances and their probable history has been made. The subsequent portions of the book group themselves naturally as follows: (1) stages of transference from the crucible to the mould, (a) liquid, (b) molten stream, (c) solidification in the ingot; (2) analysis of the casting process; (3) materials of mould construction, (4) modified and improved casting methods.

In the liquid stage the influence of slag, fluxes, and deoxidizers is examined, and also that of varying surface tension and viscosity. Considerable discussion centres round the prevention of zinc oxide formation.

In examining the processes operative during the pouring of the metal into the mould, the authors describe their own method of casting successively two alloys, similar in density and freezing point, but different as regards colour. It has thus been possible to reconstruct the physical movements within the metal during chilling. The actual solidification of the metal is

considered from the point of view of the general processes involved—contraction, feeding of liquid to fill contraction cavities, influence of pouring conditions on contraction, ingot structure, and crystal formation. There is also a section on the relationship between macrostructure and working properties.

The analysis of the casting process occupies four chapters which deal mainly with casting temperature, speed of pouring, feeding, shape of ingot, position of cooling surfaces, thickness of ingot, mould temperature and thickness, mould coating, mould position during casting, and the gas content of the metal. The significance and relative importance of each of these factors are assessed as far as possible by investigations in which the other determinants remained constant. Careful attention has been given to the study of mould materials. Greater knowledge is now available on the subject of cast-iron moulds and the various factors which affect their efficient use. The modern developments in the use of water-cooled copper-faced moulds of various types, and their influence on general industrial practice are fully discussed.

The next chapter is devoted to modified and improved casting methods and embraces a survey of the conditions that are essential for the elimination of sub-surface and surface defects. Special casting methods, *e.g.* the Durville, Ercal, and bottom casting processes, are described, and the advantages of each, and the precautions to be taken to ensure success, are pointed out.

A number of appendices have been added in order to complete the story down to the final production of the strip. They deal, respectively, with: (1) the rolling mill, including the modern four-high, cluster, Lauth three-high and Steckel mills, and the relevant annealing processes for the production of bright or dull finish; (2) the constitution and density of the brasses, embodying sections on crystal structure and equilibrium diagrams; (3) aluminium-brasses, and the influence of aluminium in decreasing the evolution of zinc vapour; (4) brasses containing phosphorus, their mechanical properties and structure; and (5) a list of papers and pamphlets on brass ingot casting which have been issued previously by the Association.

The book is one of the best publications on the subject which have appeared in recent years, and should be in the hands of all those interested in foundry work. It is concise yet comprehensive; it is presented in a most acceptable form, for which credit must be given to the publishers. Finality in foundry work has not yet been achieved, but the present volume is a creditable contribution, and is a tribute to the necessity for the re-examination of fundamentals and to the care and discrimination which the authors have exercised.—W. A. C. NEWMAN.

Recommended Methods for Testing and Control of Foundry Moulding Sands.

(B.C.I.R.A. Special Publication No. 2.) Pp. 44, with 17 illustrations. 1933. Birmingham: British Cast-Iron Research Association, 21-23 St. Paul's Sq. (10s. 6d. net.)

This is the second edition of a report issued in 1930, as No. 73, and advantage has been taken of this opportunity to make several additions and modifications. Of these the most important are the following: (1) the strength test is now carried out only under compression; (2) strength and permeability tests are carried out on the same test-piece; (3) the permeability test has been modified to permit the use of air instead of gas; (4) the use of the standard test-piece of the American Foundrymen's Association for strength and permeability tests in the standard British apparatus. The recommended methods of testing include those for sampling, milling, moisture content, ramming, mechanical analysis (including sieving, sedimentation, elutriation), tests of strength, permeability, expansion and contraction, refractoriness, chemical analysis. At the end of each section a list of the requisite apparatus is given, and illustrations of special pieces of apparatus are included. Appendices are devoted to: (1) the size and method of preparation of sand test-pieces; (2) representative results; (3) a comparison of results between various test methods, and (4) recommended apparatus. A short bibliography is given at the end.

This publication is one of the most authoritative on the testing of moulding sands.

—W. A. C. NEWMAN.

Dilatation et Retrait en Soudure Autogène. Par Marcel Piette. Demy 8vo. Édition Generale. Pp. 91, with 113 illustrations. Paris: Office Centrale de l'Acétylène et de la Soudure Autogène, 32 Boulevard de la Chapelle. (12 francs.)

This is a slightly revised version of the paper which was awarded the prize by the Société des Ingénieurs Soudures in its competition of 1932. It reviews, in a completely practical way, a subject of vital importance to the welding industry. By simple examples, clearly illustrated, the author explains the causes of distortion and residual stress produced by welding. Practical methods for minimizing residual stress, avoiding distortion, and preventing the formation of cracks, are described, and some popular remedies are shown to be ineffective in many cases. The pure metallurgist will find little of interest in this modest little work, but it will be valuable to welders, welding designers, and supervisors, to whom it will make clear the basic causes of many difficulties.—H. W. G. HIGNETT.