METALLURGICAL ABSTRACTS

(GENERAL AND NON-FERROUS)

Volume 1 DECEMBER 1934 Part 12

I.—PROPERTIES OF METALS

(Continued from pp. 477–486.)

Work of the Technical Committee : Committee for Aluminium Conductors. H. Schmitt (chairman) (*Z. Metallkunde*, 1934, **25**, 170–172).—The behaviour of the following types of free transmission conductors on the Island of Sylt during 5 yrs.' exposure is described : (*A*) 99·2% aluminium after slowly cooling from 350° C., (*B*) 99·6% aluminium, (*C*) 99·2% aluminium quenched from 500° C., Aldrey, and copper. The conductors consisted of several strands of wire twisted into a rope. The breaking load of Aldrey decreased from 180 to 160 kg., that of aluminium *B* and *C* from about 85 to 78 kg., and that of aluminium *A* from 80 to 60 kg. in 5 yrs. The decrease was linear throughout the period for Aldrey and aluminium *A*, but for aluminium *B* and *C* the decrease occurred only during the first 2–3 yrs., after which the strength remained constant. For copper the strength remained constant for the first 3 yrs., then commenced to decrease linearly with time of exposure. The surface of aluminium *B* and *C* became covered with a protective film which appeared to act as a preventive against further corrosion; the films formed on the other metals were porous and poorly adherent, and therefore afforded little protection.—A. R. P.

***On the Superconductivity of Aluminium.** W. H. Keesom (*Comm. Onnes Lab. Univ. Leiden*, 1934, (**224**), 11–13).—Aluminium becomes superconductive at 1·14° abs.—A. R. P.

***On the Change of Shape of Alternately Twisted Metal [Single] Crystals [Cadmium].** W. Fahrenhorst and H. Ekstein (*Z. Metallkunde*, 1933, **25**, 306–308).—In dynamic alternating torsion tests of metal crystals the resulting changes in cross-section can be deduced by crystallographic stress analysis from the known elements of deformation. The elements of slip which occur in the tensile test are also effective in this case. The tests were made on cadmium single crystals.—B. Bl.

***The Potential of the Cobalt Electrode.** M. M. Haring and B. B. Westfall (*Trans. Electrochem. Soc.*, 1934, **65**, 235–246; discussion, 247).—See *Met. Abs.*, this volume, p. 113.—S. G.

***The Electrolytic Valve Action of Columbium and Tantalum on A.C. Circuits.** D. F. Calhane and A. J. Laliberte (*Trans. Electrochem. Soc.*, 1934, **65**, 291–297; discussion, 297–299).—For abstract of the paper, see *Met. Abs.*, this volume, p. 285. In the discussion *F. C. Frary* suggested that the difference in the behaviour of columbium was due to the solubility of its oxide in sulphuric acid. D. F. C. agreed that the columbium electrode showed a loss in weight in sulphuric acid and stated that addition of cobalt or iron sulphates did not improve the rectifying action of columbium.—A. R. P.

Copper. H. Foster Bain and Wm. G. Schneider (*Copper Brass Res. Assoc.*, **1933**, 20 pp.).—A summarized account is given of the history, occurrence, metallurgy, properties, and uses of copper with details of production and prices from 1780 until the present time.—A. R. P.

On the Solubility of Gases in Copper. I. E. Gorshkov (*Metallurg* (*Metallurgist*), **1933**, (8), 56–60).—[In Russian.] Recent work is summarized. —N. A.

---

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

***Effect of Temperature upon the Reflectivity of Copper, Silver, and Gold.** Yoshio Fujioka and Tatsuro Wada (*Sci. Papers Inst. Phys. Chem. Res. Tokyo*, No. **525**, 1934, 9–19).—[In English.] The relative reflectivities of copper, silver, and gold have been measured at −180°, 0°, and +100° C. for the wave-length region 2500–6500 A.; the absolute values of the reflectivity were not determined. With increasing temperature the minimum reflectivity of silver in the region 3200 A. changes to the longer wave-length side, and the minimum becomes less pronounced. The results are compared with those calculated from the theories of de Kronig (*Proc. Roy. Soc.*, 1929, [A], **124**, 409; 1931, [A], **133**, 255) and Fujioka (*Z. Physik*, 1932, **76**, 537; *Sci. Papers Inst. Phys. Chem. Res. Tokyo*, 1933, **22**, 202) and the general agreement is satisfactory.—W. H.-R.

Europium, a Rare Member of the Rare Earth Group. B. S. Hopkins (*Electrochem. Soc. Preprint*, **1934**, Sept., 167–174).—An account is given of the preparation and properties of the oxide and salts of europium. The best method of separation consists in the cathodic reduction of the samarium–gadolinium–europium fraction of the rare earths in hydrochloric acid containing a little sulphuric acid, when europous sulphate is almost quantitatively precipitated in an almost pure condition. There are no commercial uses so far for the metal or its compounds.—A. R. P.

***The Change of Resistance of Single Crystals of Gallium in a Magnetic Field. —II.** W. J. de Haas and J. W. Blom (*Physica*, 1934, **1**, 465–474; *C. Abs.*, 1934, **28**, 6036).—Cf. *Met. Abs.*, this volume, p. 285. Previous work on the effect of a magnetic field on the resistance of gallium single crystals at liquid helium temperatures was extended to higher temperatures. A number of rotational diagrams and tabulated data of R versus angle or field strength with a field perpendicular to the axis of the crystal rod are given for temperatures from 155° to 49·8° abs. At each temperature a field strength exists at which the resistance is the same in the direction of the 2 short crystallographic axes; this value of the field strength decreases with a decrease in temperature.—S. G.

The Use of Lead as Protection Against X-Rays. J. Mahul (*Aciers spéciaux*, 1934, **9**, 145–151).—The relative efficiency of lead and other materials as protection against X-rays and the thickness of lead sheet to effect given reductions of intensity are discussed. The technique of the use of lead is not fixed at present, and there exist a number of systems, here described, none of which appears to be superior to the others, and each case requires its own solution to the problem (cf. *Bâtiment illustré*, **1934**, March).—J. H. W.

***The Atomic Weight of Lithium.** M. Hlasko and J. Kuszpecińska (*Bull. internat. acad. polonaise, Classe sci. math. nat.*, **1933**, [A], 523–531; *C. Abs.*, 1934, **28**, 4280).—Li_2CO_3 was submitted to a series of transformations and purifications. The pure LiCl to which it was finally converted was used in determining the ratio LiCl : AgCl. The atomic weight of lithium thus found was 6·934 ± 0·001.—S. G.

***On Alternating Torsion Tests with Magnesium Single Crystals.** E. Schmid and G. Siebel (*Metallwirtschaft*, 1934, **13**, 353–356).—In alternating torsion tests with single crystals of magnesium translation and twin-formation occurs in a similar crystallographic manner to that which occurs in the tensile test. Fracture occurs along the (0001), $(10\bar{1}0)$, $(10\bar{1}1)$, and $(10\bar{1}2)$ planes. The yield-point is first increased and then decreased with increase in the number of alternations. If the basal plane is only slightly inclined to the axis of the rod, the crystal becomes brittle in the endurance test.—v. G.

Manganese: Its Occurrence, Milling, and Metallurgy. I.—Physical Properties and Preparation of Metallic Manganese. Manganese in Non-Ferrous Alloys. R. S. Dean (*U.S. Bur. Mines Information Circ.* No. **6768**, 1934, 1–13).—A review.—S. G.

Manganese: Its Occurrence, Milling, and Metallurgy. V.—Bibliography. —— (*U.S. Bur. Mines Information Circ.* No. 6772, 1934, 309–334).—Includes 405 references.—S. G.

***Mercury Crystals.** E. Grüneisen and O. Sckell (*Ann. Physik*, 1934, [v], **19**, 387–408).—Crystals of mercury are obtained by cooling the metal to − 190° C. in a gypsum tube; heating to − 79° C. produces recrystallization. The density is 14·47, the linear coeff. of expansion 47×10^{-6} parallel to the trigonal axis and $37 \cdot 5 \times 10^{-6}$ perpendicular thereto, and the cubic coeff. of expansion 122×10^{-6}. Young's modulus has been determined on 19 crystals by the bending vibration method and the torsion modulus by static torsion tests. The elastic constants at − 190° C. are as follows (in 10^{-12} cm.²/dyne): $s_{11} = 15 \cdot 4$, $s_{33} = 4 \cdot 5$, $s_{44} = 15 \cdot 1$, $s_{12} = -11 \cdot 9$, $s_{13} = -2 \cdot 1$, $s_{14} = -10$. The greatest moduli (in dynes/cm.²) are: $E_{\text{max}} = 3700 \times 10^8$, $G_{\text{max}} = 662 \times 10^8$; $E_{\text{min}} = 529 \times 10^8$, $G_{\text{min.}} = 214 \times 10^8$.—v. G.

***Conductivity of Liquid Mercury at High Temperatures and Pressures.** Francis Birch (*Phys. Rev.*, 1932, [ii], **40**, 1054).—Abstract of a paper read before the American Physical Society. The electrical conductivity of mercury was measured in the region between 0 and 1100° C., and from 1 to 4000 atm. In this region the specific resistance increases with temperature, and decreases with increasing pressure. Taking the specific resistance at 0 and 1 atm. as 1·00, the resistance at 1100° C. and 1000 atm. is about 4·5, at 1100° C. and 4000 atm. about 2·9. Both $1/\rho(\delta\rho/\delta T)_p$ and $1/p(\delta\rho/\delta p)_T$ decrease as p increases, and increase as T increases. The boiling curve of mercury has been retraced, by an electrical method, and indications found of the liquid–vapour critical point, at about 1460° C. and 1600 atm. The criterion applied was the continuous variation of resistance with increasing temperature, at constant pressure.—S. G.

Purification of Mercury Containing Metallic Impurities. W. F. Alewijn (*Chem. Weekblad*, 1933, **30**, 687; *C. Abs.*, 1934, **28**, 4283).—Air is passed through the mercury at 90° C., in the light, when zinc, lead, &c., oxidize readily and may be removed by filtration. Final treatment with nitric acid is recommended. The air that has passed through the mercury should be bubbled through water to condense mercury vapour.—S. G.

***Variation with Temperature of the Coefficient of Thermal Expansion of Nickel Monocrystals Near the Curie Point.** Clarke Williams (*Phys. Rev.*, 1934, [ii], **45**, 741).—Abstract of a paper read before the American Physical Society. The coeff. of thermal expansion of single and poly-crystalline nickel have been measured at 5° intervals between 250° and 400° C. The value of the coeff. increases smoothly from $15 \cdot 3 \times 10^{-6}$/° C. at 250° C. to a maximum of $18 \cdot 0 \times 10^{-6}$/° C. at 355° C. At this temperature the coeff. decreases rapidly to a value of $16 \cdot 5 \times 10^{-6}$/° C. at 370° C., the Curie point, and thereafter remains nearly constant. The maximum value of the coeff. and the temperature at which the maximum occurs are lowered by impurity in the specimen.—S. G.

The Electrical Resistance of Thin Films of Nickel Prepared by Electrodeposition. R. C. L. Bosworth (*Trans. Faraday Soc.*, 1934, **30**, 549–554).—Thin films of nickel 0·08–2·5 μ thick have been prepared by electrodeposition on polished stainless steel cathodes, from which they have subsequently been stripped after coating with shellac. The electrical resistance of such thin films is about twice that to be expected from their thickness, and the temperature coeff. of resistance is about 66% of that of more massive nickel. The resistance of a film 0·08 μ thick increases extraordinarily rapidly between 40° and 55° and decreases sharply again between 55° and 80° C.; this effect disappears after annealing at 80°–100° C., but reappears after storage at room temperature for a few days.—A. R. P.

Equation of State and the Elementary Carrier of Magnetism for Nickel. L. Néel (*J. Phys. Radium*, 1934, **5**, 104–120; *Sci. Abs.*, 1934, [A], **37**, 635).—A model to represent the magnetic properties of nickel is proposed in which it is assumed that the interactions between the carriers of magnetic moment are of 2 kinds: long-distance forces between groups of carriers giving rise to a Weiss molecular field, and forces between the members of a single group, the latter forces being subject in a marked degree to the phenomenon of fluctuations. The properties of this model are worked out quantitatively and compared with the experimentally determined properties of nickel, susceptibility in weak fields and, near the Curie point, in strong fields, spontaneous magnetization, specific heat anomaly at the Curie point, &c. The hypothesis of fluctuations is shown in this way to yield a satisfactory theory of the magnetization of nickel. The application of the quantum theory to the model calls for certain corrections which are worked out. The calculations are based on the view that the magnetic properties of nickel are due to magnetic carriers each possessing a resulting spin $S = 1/2$, and varying in number from 0·607 per atom at saturation to 0·867 per atom for weak magnetizations. N. gives reasons for believing this to be the only acceptable hypothesis.—S. G.

***Catalytic Activity and Ferromagnetism [Nickel].** J. Arvid Hedvall and E. Gustavson (*Svensk Kem. Tids.*, 1934, **46**, 64–65; *C. Abs.*, 1934, **28**, 4971).—It has been shown recently that the reactivity of solids is increased by phase transformations that do not affect the lattice structure. Hence it is important to investigate whether the disappearance of ferromagnetism produces a similar change. For this purpose experiments were carried out on the reaction $N_2O = N_2 + O$, with pure nickel as the catalyst, at 330°–380° C., since no alteration in the nickel lattice has been observed in a temperature interval of 1000° C. Between 330° and 359° C. the decomposition was constant, but at approximately 359° C. there was an abrupt rise in the decomposition–temperature curve. The Curie temperature for this specimen of nickel was 358°–360° C. Control experiments with nitrogen or oxygen instead of nitrous oxide gave curves without this sharp break, as also did experiments with nitrous oxide over nickel oxide. Experiments with other samples of nickel with different Curie points showed the same agreement between the temperature at which the break occurs and the Curie temperature. The sudden application of a magnetic field, either above or below the Curie point, produced no appreciable effect on the decomposition.—S. G.

†**The Kinetics of Adsorption Processes. II.—The Occlusion of Hydrogen by Palladium. I.—Discussion.** A. R. Ubbelohde (*Trans. Faraday Soc.*, 1932, **28**, 275–283).—From a review of recent work it is concluded that hydrogen is adsorbed by the palladium lattice in the atomic states, the reaction $H_2 = 2H$ being catalyzed by the surface.—A. R. P.

***The Kinetics of Adsorption Processes. II.—The Occlusion of Hydrogen by Palladium. II.—Dynamic Isothermals.** A. R. Ubbelohde and A. Egerton (*Trans. Faraday Soc.*, 1932, **28**, 284–291).—Isothermals for the removal of adsorbed hydrogen from palladium are given for 306°, 218°, 156°, and 100° C. Only at 100° C. is any part of the hydrogen removed at approximately constant pressure, but even this depends on the activity of the palladium.—A. R. P.

***Diffusion of Hydrogen Through Palladium and Through Palladium–Nickel Double Layers.** W. R. Ham (*Phys. Rev.*, 1934, [ii], **45**, 741).—Abstract of a paper read before the American Physical Society. The diffusion of hydrogen through a double layer consisting of 10 mil palladium welded to 5 mil nickel by means of ½ mil copper foil was found to be very nearly reversible at all temperatures and to follow the ordinary law of diffusion (1) $R = A\varepsilon^{b/T}$, in which the value of b is similar to that of nickel, *viz.* 6600° approximately.

The diffusion of pure dry hydrogen through carefully degassed palladium gives the same value as above mentioned. However, palladium shows a complex behaviour for the diffusion of hydrogen if the metal has been in contact with certain gases at elevated temperatures. Nitrogen in particular seems very slowly to diffuse through it, and greatly increases, for a long time, the ability of the palladium to transmit hydrogen. Nevertheless, after treatment with nitrogen a simple formula such as (1) still represents the results for a limited time over a range from 250° to 750° C., the value of b for nitrogen-charged palladium being as low as 3900° in some cases and the value for A in general much greater than for degassed palladium. Fresh massive palladium, 30 or 40 mil thick, may be very permeable to nitrogen, however. This permeability appears too great to be ascribed to a nitrogen compound. Carbon monoxide is suggested as an alternative to nitrogen. To remove the cause of the great permeability, baking at 1000° C. for several hrs. in a hydrogen atmosphere appears necessary, whereupon the rate of diffusion may be only $\frac{1}{10}$ of its original amount.—S. G.

***The Diffusion of Hydrogen Through Metals: Fractionating the Hydrogen Isotopes.** Colin G. Fink, Harold C. Urey, and D. B. Lake (*J. Chem. Physics*, 1934, **2**, 105–106; *C. Abs.*, 1934, **28**, 2264).—Two sheets of steel welded together and used as cathode in the electrolysis of an acid solution eventually bulged because of the pressure of hydrogen between the sheets. Similar effects were obtained with tubes of iron, nickel, and palladium. A palladium tube was then used as cathode in a solution containing fuming sulphuric acid and special water, the latter containing 0·5% "heavy water." At the end of 28 hrs. the hydrogen that had diffused through the palladium was analyzed after having been converted to water. Its density was 1·00020, showing that some fractionation of hydrogen isotopes had occurred. The rate of passage of hydrogen through the palladium was also determined but no oxygen passed through when the palladium was made anode. On the basis of the overvoltages involved, calculation shows that the pressures of hydrogen passing through the metal are of the order of a million atm.—S. G.

***The Occlusion and Diffusion of Hydrogen in Metals. A Metallographic Study of Palladium–Hydrogen.** Donald P. Smith and G. J. Derge (*Electrochem. Soc. Preprint*, **1934**, Sept., 25–42).—Photographs of the structure of palladium after various heat and mechanical treatments and before and after exposure to hydrogen are shown, and from a detailed discussion of the changes which occur in the structure during absorption of hydrogen it is concluded that the principal or most rapid entry of the gas either during cathodic charging or on exposure to the gas is along certain widely spaced members of the dodecahedral and octahedral sets of planes which intersect the surface; from these lateral diffusion occurs along similar planes in the interior of the metal, and eventually lattice occlusion occurs. The penetrability along only a certain number of planes can be explained by the presence of fissures produced by octahedral cleavages of various orders. Vacuum-fused palladium takes up hydrogen very slowly, and is much more difficultly attacked than metal which has been recrystallized *in vacuo* at 400° C. After annealing at 800° C. the metal becomes more inert to etching reagents and less permeable to hydrogen than the vacuum-fused metal. Rolled foil readily occludes hydrogen, and is readily attacked by etching reagents.—A. R. P.

***A Note on the Electrode Potential of Palladium Black in Buffer Solutions.** Paul Nylén (*Arkiv Kemi, Mineral. Geol.*, 1934, **11B**, (32), 6 pp.; *C. Abs.*, 1934, **28**, 4293).—The potential of palladium black was measured in buffer solutions not saturated with hydrogen and found to be + 65 mv. greater than the e.m.f. of a hydrogen electrode in the same buffer. This value remains constant for hours, even in the presence of oxidation–reduction systems. After a time, however, the potential rises to another constant value. The first value may be re-established by recharging with hydrogen by gas, cathodic polarization, or immersion in a strong reducing agent such as hypophosphite.—S. G.

***The Kinetics of the Adsorption of Hydrogen on Platinum and Nickel.** E. B. Maxted and N. J. Hassid (*Trans. Faraday Soc.*, 1932, **28**, 253–261).—Absorption of hydrogen on nickel and platinum is first very rapid but eventually takes place slowly; the magnitude of the slow adsorption process increases at first with increase in temperature and then decreases to zero at the temperature at which expulsion of the adsorbed gas takes place. The adsorptive power at low temperatures is increased by a previous anneal at high temperatures without degassing; this effect increases with a repetition of the heating until it finally reaches a constant value when the metal is fully activated. —A. R. P.

***The Contamination of Platinum by Graphite.** L. J. Collier, T. H. Harrison, and W. G. A. Taylor (*Trans. Faraday Soc.*, 1934, **30**, 581–587).—When platinum is melted in a graphite crucible the melting point is reduced to 2007 ± 3° abs. (1734° C.) and the metal contains 1·2% carbon, about 0·25% of which is in solid solution. Micrographic examination revealed a completely eutectiferous structure of platinum and graphite crystals.—A. R. P.

***The Freezing Point of Platinum.** F. H. Schofield [with a note by D. Turner] (*Proc. Roy. Soc.*, 1934, [A], **146**, 792–817).—The freezing point of platinum on the International Temperature Scale, was determined by measuring the brightness, for a certain wave-length, of black-body radiators maintained at the freezing points of platinum and gold. The radiators consisted of hollow refractory enclosures immersed in the molten metals which were heated by induction, and also for gold in a resistor type of furnace. Observations on five platinum ingots and two gold ingots gave a mean value 1773·$_3$° C. ± 1° C. for the freezing point of platinum. A note by *D. Turner* on the refractory materials employed is appended.—J. S. G. T.

***The Electrical Resistance of Platinum at Low Temperatures.** W. J. de Haas and J. de Boer (*Physica*, 1934, **1**, 609–616; and *Comm. Onnes Lab. Univ. Leiden*, No. **231**, 1934; *C. Abs.*, 1934, **28**, 6040).—Accurate determinations were made of the resistance of very pure platinum at temperatures from 1° to 20° abs. as determined by platinum thermometer, gas thermometer, and vapour pressure of helium. The impurity of the platinum was less than 10^{-4} % copper, 10^{-3} % lead. Two 0·15 mm. wires were used of $R_0 = 1{\cdot}3$ and 0·73 ohms; one was somewhat deformed mechanically. The experimental data cannot be represented by simple formulæ such as AT^B with $B = 2$ or 5 (Houston, *Z. Physik*, 1928, **48**, 449) or by the Vonsovskii equation (*Physikal. Z. Sowjetunion*, 1934, **5**, 115–130). The curves for the 2 wires ran parallel. From a logarithmic graph it is seen that between 0° and 4° abs. the temperature dependence of the resistance is of the order T^2; at 20° abs. of the order of T^4.—S. G.

***Surface Reactions at Very Low Pressures. I.—Platinum–Chlorine. B.—Process on the Finely-Divided Metal.** C. Nogareda (*Anales soc. españ. fis. quim.*, 1934, **32**, 396–431; *C. Abs.*, 1934, **28**, 6054).—A sublimed platinum layer adsorbs at 0° a limiting, unimolecular chlorine film, stable to about 150° C. When the wire is heated in the platinum vessel to above 200° C., with vessel walls at 0° C., the layer suffers a superficial attack by chlorine molecules previously activated by a hot, metallic surface. A $PtCl_4$ film forms, which prevents progressive attack. The kinetics are $(dp/dt) = ap/(p_0 - p)^n$, n varying from 0 to 1, according to the amount of surface and degree of saturation of the layer. In the temperature interval 200°–500° C., energies of activation of 14,000–15,000 cal. were determined. The degree of saturation of the layer is proportional to the area of the walls, but is independent of layer depth, because the attack does not penetrate the uppermost films of sublimed platinum. A reduced platinum layer was obtained by thermal decomposition of $PtCl_4$ previously formed on the vessel walls. Such a reduced platinum layer is less adsorptive and less reactive, requiring greater activation energies. Adsorption power and attacking power decrease to about half the value for the same geometric area of sublimed platinum layers. This difference can be explained by assuming sintering during attack, since the temperature of 400° C. in $PtCl_4$ reduction does not change appreciably the superficial activity of the sublimed platinum.—S. G.

***Physical and Chemical Properties of Rhenium.** C. Agte, H. Alterthum, K. Becker, G. Heyne, and K. Moers (*Tech. wiss. Abhandl. Osram-Konzern*, 1934, **3**, 124–126).—See *J. Inst. Metals*, 1931, **47**, 259.—v. G.

***The Exact Measurement of the Specific Heats of Solid Metals at High Temperatures. XII.—Specific Heat of Rhenium.** F. M. Jaeger and E. Rosenbohm (*Proc. K. Akad. Wet. Amsterdam*, 1933, **36**, 786–788).—[In English.] The specific heat c_p for rhenium at 0°–1200° C. is given by $0{\cdot}03256 + 0{\cdot}6625 \times 10^{-5}t$. —S. G.

***On the Constant Paramagnetism of Metallic Rhenium.** N. Perrakis, L. Kapatos, and P. Kyriakidis (*Praktika*, 1933, **8**, 163–168; *Chem. Zentr.*, 1934, **105**, II, 404).—[In Greek, with French summary.]—The paramagnetism (χ) of rhenium per gramme-atom at $-$ 79° to $+$ 20° C. is given by the expression: $\chi = 186{\cdot}31 \times 0{\cdot}369 \times 10^{-6} = 68{\cdot}7 \times 10^{-6}$.—A. R. P.

Bactericidal Action of Silver on Typhoid and Colon Bacilli. A. Kling (*Compt. rend.*, 1932, **194**, 1402–1404; *Brit. Chem. Abs.*, **1932**, [A], 655).—The bactericidal action of silver on *B. coli* and typhoid bacilli is accounted for by the solubility of silver in water.—I. M.

***The Manufacture of Ductile Tantalum by the Growing Process in a Current of Hydrogen.** K. Moers (*Metallwirtschaft*, 1934, **13**, 640–643).—By thermal decomposition of tantalum pentachloride on a thin tungsten wire maintained at 1200°–1450° C. in a slow current of hydrogen at atmospheric pressure a tantalum wire 2 mm. thick can be built up in 15 minutes. The wire is very ductile and malleable, but becomes brittle if the temperature is allowed to rise much above 1500° C. owing to adsorption of hydrogen. The non-adsorption of hydrogen below 1450° C. is attributed to the fact that the tantalum is deposited in an undeformed state in which it has a much lower affinity for hydrogen than when it has been deformed. Grown tantalum wires will absorb up to about 7·8% hydrogen at 2000° C. Niobium can be prepared in a similar way to tantalum and exhibits similar properties, but is somewhat less ductile.—A. R. P.

***Measurement of the Latent Heat of Thallium in Relation to the Transition in a Constant External Magnetic Field from the Superconductive to the Non-Superconductive State.** W. H. Keesom and J. A. Kok (*Physica*, 1934, **1**, 503–512; and *Comm. Onnes Lab. Univ. Leiden*, No. **230**, 1934; *C. Abs.*, 1934, **28**, 6036).—The specific heat of a block of thallium was measured by slowly heating it in a liquid helium bath to temperatures around the transition point (1·6°–4° abs.) with and without an external magnetic field. A specially calibrated phosphor–bronze resistance thermometer was used with 0·4 ma. measuring current. For field strengths of 33·6 and 59·9 gauss, respectively (applied at 4·2° prior to cooling), in the direction of the geometrical axis of the thallium the atomic heat curve shows definite peaks at 2·11° and 1·91° abs., respectively, corresponding with the transition points. Above and below these temperatures the curve approximates the specific heat curves without an external field above and below the transition point. From these curves values are derived for the latent heat of transition of 0·000276 and 0·000346 cal. per mol., respectively. By using these values in a reversible cycle including the transition point (Gorter, *Arch. Teyler*, 1933, **7**, 378) it is calculated that the over-all entropy change is zero, and hence no indication is found of irreversibility of the transition either with or without a magnetic field. From a slight discrepancy between calculated and measured magnetic transition heats it is concluded that the thallium block is only partly superconductive, and it is assumed that the superconductive fraction depends on the intensity of the magnetic field and the temperature to which the metal has been cooled. The fraction in the present experiments was from 90 to 95% (cooling to 1·4°–1·7° abs.). The non-superconductive cores in which the magnetic lines of force are contracted during the cooling process do not expand again until the transition point is reached.—S. G.

***Further Calorimetric Experiments on Thallium.** W. H. Keesom and J. A. Kok (*Physica,* 1934, **1**, 595–608 ; and *Comm. Onnes Lab. Univ. Leiden,* No. **232**, 1934; *C. Abs.*, 1934, **28**, 6037).—Cf. preceding abstract. The work was extended to include specific heat measurements on thallium with a magnetic field applied in the superconductive state, and the cooling effect brought about by applying to a superconductor a magnetic field stronger than the threshold value. The conclusion as to reversibility of the transition process was corroborated. It is thus evident that no Joule heat is developed by the persistent currents while the metal plus field passes over into the non-superconductive state. Evidently the surplus energy (twice as much energy is required from the solenoid as corresponds with the resultant field energy) is absorbed in another reversible type during the transition process. When a field of 26·4 gauss is applied to the thallium at 4·2° abs. and the temperature is decreased to 1·92°, the field removed and the specific heat determined up to 2·40° abs., the atomic heat from 2·14° on exceeds the ordinary value; the curve goes with a sharp bend through a minimum and again rises to the normal value at 2·27° abs. This course of events is explained by the contracted non-superconductive "threads" of lines of force in the metal surrounded by superconductive metal. The lines expand with heat absorption until the magnetic field in the threads reaches the threshold value, with consequent reversion of the threads to the superconductive state and heat liberation. These observations were based on the behaviour of the thermometer inside the thallium core. Temperature measurements during transition to the superconductive state with increasing field strength revealed that the surplus energy absorbed in the previous transition is entirely recovered. At very low temperatures 1·3°–1·4° abs., with magnetic fields of 150 and 360 gauss (non-superconductive metal), the atomic heat of thallium is higher than that of superconductive thallium, contrary to the usual relative values.—S. G.

The Properties of Tin. E. S. Hedges and C. E. Homer (*Tech. Publ. Internat. Tin Res. Development Council,* Series B, No. **1**, 1934, 1–45).—A comprehensive compilation of data on the atomic, crystallographic, mechanical, thermal, electrical, magnetic, and optical properties of tin.—E. S. H.

***The Cuttability ["Zerspanbarkeit"] of Single Crystals of Tin.** Erich Schmid (*Metallwirtschaft,* 1934, **13**, 301–304).—The cuttability of single crystals of tin along various crystallographic directions has been determined by the method of Leyensetter (*J. Inst. Metals,* 1928, **39**, 652). The results are shown in pole figures for various orientations. The relative cuttability of single crystals of tin is $2{\cdot}74 \times 10^{9}$ ergs/cm.^{3}, whereas that of polycrystalline tin with a grain-size less than 1 mm. is $3{\cdot}09 \times 10^{9}$ ergs/cm.^{3}. A space model of cuttability cannot be constructed, since the value varies by as much as 8–12% in opposite directions along the same crystal axis. These variations are attributed to the fact that the workability of a metal does not reside in the surface but in a direction at an angle of about 2½° thereto.—A. R. P.

***Magnetism of Tin.** S. Ramachandra Rao (*Proc. Indian Acad. Sci.*, 1934, Sect. A, **1**, 123–142).—Massive white tin powder has a magnetic susceptibility (K) of 0·0360 at 32°–33° C.; on heating the metal, K remains constant at this value up to 220° C. At the melting point (233° C.) K decreases rapidly to $-0{\cdot}0455$, and regains the value $+ 0{\cdot}0360$ on cooling the metal to 30° C. The susceptibility of colloidal tin powders becomes increasingly diamagnetic as the particle size decreases. On melting and recrystallizing, the substance becomes again paramagnetic. These results are not attributable to any chemical or ferromagnetic impurities. The paramagnetic susceptibility of white tin is not an atomic property, but depends on the crystal structure of the metal. The atomic susceptibility of white tin is very nearly the value ($-41\cdot54 \times 10^6$) found experimentally for grey tin.—J. S. G. T.

***A Note on the Ratio of the Thermal Coefficient of Expansion to the Specific Heat at Constant Pressure for Tungsten.** Wilfrid J. Jackson (*Phys. Rev.*, 1934, [ii], **45**, 285).—Abstract of a paper read before the American Physical Society. The variation of the ratio $\alpha : C_p$ with temperature has been worked out for tungsten by using the recent careful measurements and the empirical relationship obtained from the data of Bronson, Chisholm, and Dockerty (*Met. Abs.*, this volume, p. 162). The best available data on the thermal coeff. of expansion are used. It is found that the ratio is constant for only a limited range of temperature for which the empirical relationships are applicable. Above 200° C. the ratio increases continuously with temperature up to 500° C., where the validity of the relationships ceases.—S. G.

***Change in Conductivity of a Metal [Tungsten] Foil by the Action of an Electric Discharge.** M. Pierucci (*Nuovo cimento*, 1932, **9**, 33–42; *Sci. Abs.*, 1932, [A], **35**, 742).—Repeats the experiments of Perkins on the conductivity of metallic films charged to a high positive or negative potential. The films were of tungsten deposited on glass, and were charged by Holtz machines through a high-water resistance. P. found a well-marked effect of the charge. It was asymmetrical, the resistance decreasing for a negative charge and increasing slightly for a positive one. The film cannot have contained more than about 4·2 atomic layers. At 10,000 v. the number of electrons abstracted from the atoms would be 8·5, whereas the number of valency electrons effecting the electrical conductivity of tungsten is 6 per atom. Apart from the uncertainty regarding the thickness of the film there is, however, a fairly good theoretical agreement.—S. G.

***On the Production of Very Thin Tungsten Wires.** J. F. H. Custers (*Nederl. Tijdschr. Natuurkunde*, 1934, **1**, 8–15; *Chem. Zentr.*, 1934, **105**, II, 1738).—By cathodic disintegration of a tungsten wire 10^{-3} cm. thick in a discharge tube containing argon, wire thinner than 2×10^{-4} cm. can be obtained. The diameter decreases linearly with the time when the current is kept constant, but preferably the process is started with 0·1 milliamp., and this is gradually reduced as the wire gets thinner.—A. R. P.

***The Diffusion of Molybdenum into Tungsten.** J. A. M. van Liempt (*Rec. trav. chim.*, 1932, **51**, 114–132; *Chem. Abs.*, 1932, **26**, 2359).—Molybdenum was deposited on tungsten cores of polycrystalline and single-crystal wire by heating these cores in a mixture of $MoCl_5$ vapour and hydrogen at 800° C. Results showed that at the same temperatures the diffusion of molybdenum into the tungsten is less for single-crystal than for polycrystalline wire, and the rate of diffusion increases at higher temperatures. A general formula was derived for the diffusion of 2 regular, single-crystal metals which form a continuous series of solid solutions: $D = (8/3\pi)p^2\gamma e^{-3b^2T_s/T}$, where $p =$ minimum atomic distance in the metal in which diffusion occurs, $\gamma =$ characteristic monochromatic atomic frequency of diffused metal which is easily calculated by Lindemann's formula, $T_s =$ melting point of diffused metal, and $T =$ temperature at which diffusion occurs. The formula $\log_{10}D_u = -(17{,}500/T) - 3\cdot20$ holds for the diffusion of molybdenum in single-crystal tungsten; this is in good agreement with the above diffusion formula. The diffusion of molybdenum in polycrystalline tungsten depends on the grain-size and total surface of the tungsten as well as on the condition of the grain boundaries and is therefore not represented by any general formula.—S. G.

***Thermionic Work-Function of Thoriated Tungsten at Zero Field.** N. B. Reynolds and W. B. Nottingham (*Phys. Rev.*, 1934, [ii], **45**, 765).—

Abstract of a paper read before the American Physical Society. The work-function of thoriated tungsten has been determined at zero field by the T^2 formula. At the same time the effective transmission coeff. and the temperature coeff. of the work-function were determined from the energy distribution and the contact potential shift. The observed results are accurately represented by the formula $I = ADT^2 \exp\{-(e\phi_0 + \alpha kT\}$ where $A = 120$ amp./cm.²/deg.² as given by the theory, $D = 0{\cdot}36$, $\phi_0 = 2{\cdot}83$ electron-volts, and $\alpha = 2{\cdot}0$. These values must be taken as provisional since they apply to only one filament. Measurements of emission at zero field and at 6000 v. per cm. (100 v. applied) as a function of the time of activation at 1925° K., showed that the emission reaches a maximum with the high field at almost exactly $\frac{2}{3}$ the time required to obtain a maximum emission at zero field. This seems to indicate that the maximum average dipole moment per unit area is found with a complete monomolecular film, while 67% coverage gives the maximum emission with moderate accelerating fields, as was found by Langmuir and Taylor for cæsium.—S. G.

***The Effect of Temperature on Electron Field Currents from Thoriated Tungsten.** A. J. Ahearn (*Phys. Rev.*, 1934, [ii], **45**, 764–765).—Abstract of a paper read before the American Physical Society. Measurements, similar to those on clean surfaces (*ibid.*, 1933, [ii], **44**, 277), have been made on the effect of temperature on electron field currents from thoriated tungsten. Measurements were made with different amounts of thorium on the surface. The observed currents at high fields (from 4×10^5 to 9×10^5 v/cm.) were independent of temperature to about 5% from 300° to about 1100° K., when the thermionic activity was only slightly greater than that for clean tungsten. When the thermionic activity was increased to approximately that of fully thoriated tungsten this independence of measured current extended only to about 900° K. Above these temperatures current values detailed by subtracting the room temperature current from those at higher temperatures satisfied the Richardson thermionic emission law as well as direct measurements thereof. All the data have now shown that there is no evidence of any temperature effect on field currents from clean molybdenum and tungsten surfaces and from tungsten contaminated with thorium. The measurements are consistent with the assumption that the field currents are constant and independent of temperature and that the thermionic emission accounts for all of the observed variations with temperature.—S. G.

***Thoriated Tungsten Filaments.** Irving Langmuir (*J. Franklin Inst.*, 1934, **217**, 543–569).—The diffusion coeff. of thorium through tungsten crystals, along grain boundaries and over the free filament surface, are calculated. The probable mechanism of the production of the metallic thorium within the filament is discussed. At 2400° C. the thorium which arrives at the surface along grain boundaries, does not spread over the surface as it does at lower temperatures (1900°–2100° C.).—S. V. W.

***New Experiments on the Mechanism of the Catalysis of Ammonia on Tungsten.** W. Frankenburger and A. Hodler (*Trans. Faraday Soc.*, 1932, **28**, 229–242).—The metal used was tungsten powder with an average grain-size of $1{\cdot}86 \times 10^{-4}$ cm. and a macroscopic surface of 1700 cm.²/grm., reduced in H_2 at 750° C., and cooled *in vacuo*. Hydrogen adsorption by this active tungsten is not strictly proportional to the pressure, especially at very low pressures, and between 90° and 150° C. increases with increase in temperature at constant pressure. At 20°–60° C. adsorption of ammonia on active tungsten increases rapidly with the pressure at low pressures and is independent of the amount of adsorbed hydrogen. The adsorption of ammonia and of hydrogen is increased by the presence of large quantities of ammonia decomposition products on the tungsten but is unaffected by small quantities. Between 90° and 250° C. activated tungsten decomposes ammonia with the formation of tungsten imide and nitride and the liberation of hydrogen. The nature of the catalytic action is discussed at length, and the effects of temperature and pressure on its course have been determined.—A. R. P.

†**Zinc and Its Alloys.** Arthur Burkhardt (*Metallwirtschaft*, 1934, **13**, 387–395, 461–468, 495–500, 576–580, 607–612, 625–627; and (part translation only) *Light Metals Research*, 1934, **3**, 130–133, 141–159).—An extraordinarily complete review of the literature on the mechanical, chemical, and physical properties and the working of zinc and its alloys, especially those used for die-casting. Equilibrium diagrams of the most important binary systems are included.—v. G.

***Thermoelectric Forces Produced by Torsion of Zinc and Cadmium Wires.** G. Tammann and G. Bandel (*Ann. Physik*, 1934, [v], **19**, 582–584).—A twisted zinc wire has a thermoelectric force of about 10^{-6} v. against an untwisted zinc wire but this effect disappears after about ½ hr. at 30° C. On repeating the twisting of the wire after recovery the thermoelectric force increases much more rapidly than in the first case. Cadmium wires behave similarly.—v. G.

***The Recovery of the Electrical Resistance and the Hardness of Zinc, Magnesium, and Other Readily Fusible Metals after Cold-Work.** G. Tammann and K. L. Dreyer (*Ann. Physik*, 1934, [v], **19**, 680–688).—The recovery of the electrical resistance of twisted wires of zinc, cadmium, thallium, lead, and tin with time has been determined at $-$ 10° to $+$ 30° C., and the softening of zinc after cold-rolling measured. The recovery and recrystallization of magnesium takes place within the range 100°–200° C.—v. G.

†**The "Single-Crystal" State of Metals.** H. C. H. Carpenter (*Bull. Inst. Min. Met.*, 1934, (**357**), 13–34; and (summary) *Met. Ind.* (*Lond.*), 1934, **44**, 557–560, 584–587).—Presidential address, dealing with the production of single crystals from vapour, liquid, and solid phases; the orientation of crystals in single-crystal test-pieces, and the properties of single-crystal metals. A *bibliography* of 33 references is given.—I. M.

Use of Single Metal Crystals for Gramophone Records. A. E. van Arkel and A. T. van Urk (*Physica*, 1934, **1**, 425–426; *Brit. Chem. Abs.*, **1934**, [B], 583).—Gramophone records made from a single metal crystal, or a small number of such crystals, *e.g.* aluminium, have the sound properties of an amorphous plate. Distortion effects due to crystal boundaries are eliminated.
—S. G.

***Tension Coefficient of Resistance of the Single Hexagonal Crystals, Zinc and Cadmium.** Mildred Allen (*Phys. Rev.*, 1934, [ii], **45**, 757).—Abstract of a paper read before the American Physical Society. The work on the tension coeff. of electrical resistance of single metal crystals which was begun with the trigonal crystals bismuth and antimony (*J. Inst. Metals*, 1933, **53**, 225, 289) has been extended to the hexagonal crystals zinc and cadmium. Experimentally they were somewhat more difficult to work with because of their lower specific resistance, smaller tension coeff., and lower elastic limit. According to Bridgman's theory (*J. Inst. Metals*, 1933, **53**, 230–231), hexagonal crystals may be considered as a degenerate case of trigonal crystals in which the constant which determines the variation of the tension coeff. with the orientation of the secondary cleavage planes becomes zero. Hence the tension coeff. of these hexagonal crystals should depend only on the orientation of the primary cleavage planes with respect to the direction of the current and the tension; this has been verified experimentally.—S. G.

Elastic After-Effect in Metals. M. F. Sayre (*J. Rheology*, 1932, **3**, 206–211). —Similar to *Proc. Amer. Soc. Test. Mat.*, 1932, **32**, (II), 584–592; see *J. Inst. Metals*, 1932, **50**, 468.—S. G.

Group Phenomena in Metal Crystals. A. Goetz (*Phys. Rev.*, 1934, [ii], **45**, 293).—Abstract of a paper read before the American Physical Society. Discussion of experimental results concerning properties of metal crystals which depend on the magnitude of the crystal. Most properties typical for a solid metal seem to be caused by large but limited groups of molecules. The "critical" size above which a property of a crystal becomes size-independent lies for the metals investigated between 10^7 and 10^9 atoms. Evidence indicating the existence and size of such groups has been obtained by the study of the magnetic properties of microscopic crystals of graphite, bismuth, and antimony, and by the determination of the effects of foreign atoms inserted in small concentrations into macroscopic crystals. The magnitude of the groups derived for different properties but for the same crystal comes out to be the same. There seems to be a close analogy between these group phenomena and the "swarm" effects observed in anisotropic crystals.—S. G.

***Danger of Fracture and X-Ray Interference Lines.** P. Ludwik and R. Scheu (*Metallwirtschaft*, 1934, **13**, 257–261).—Photometric measurements of the broadening of X-ray interference lines show that marked broadening first occurs after the yield-point has been exceeded. The broadening of the lines at fracture is strongly dependent on the nature of the stress and the pretreatment. Under alternating stress a smaller degree of broadening occurs than in the tensile test. Age-hardening produces in some cases a still greater broadening than takes place in the tensile test.—v. G.

***Internal Dissipational Resistance to Distortion in Solids and Its Correlation with Other Physical Properties.** R. L. Wegel and H. Walther (*Phys. Rev.*, 1932, [ii], **41**, 402).—Abstract of a paper read before the American Physical Society.—S. G.

Magnetism and Plasticity. Francis Bitter (*Phys. Rev.*, 1932, [ii], **41**, 401). —Abstract of a paper read before the American Physical Society.—S. G.

***Gases in Metals, with Special Reference to Non-Ferrous Metals.** W. Koch (*Z. tech. Physik*, 1934, **15**, 280–284).—Apparatus and methods for the determination of gases contained in metals are discussed briefly. Results relating to aluminium and zinc, the solubility of hydrogen and nitrogen in aluminium and copper and alloys of these metals, and of these gases together with carbon monoxide and carbon dioxide in copper and copper alloys are briefly discussed. The gas-content of commercial aluminium is 1–2 c.c./100 grm. of metal; that of electrolytic zinc is proportional to the square root of the current density employed in the electrolysis. The gas content of metals is proportional to the square root of the gas pressure. Solubility of hydrogen in aluminium commences at about 700° C. and increases steadily up to 1000° C.; solubility of hydrogen in copper begins at about 500° C., increases slowly up to about the m. p., and then increases suddenly from 2 c.c./100 grm. to 5·4 c.c./100 grm. of metal, thereafter increasing regularly with increase of temperature.—J. S. G. T.

***The Evolution of Gas from Worked Metals.** O. Werner (*Z. Elektrochem.*, 1933, **39**, 611–615).—Abstract of a paper read before the Deutsche Bunsen-Gesellschaft für angewandte physikalische Chemie. From the emanation given off when radium is alloyed with barium and zinc, inferences are drawn as to the state and the changes of state of the metals. On working the alloys, the change in their density caused an increase in the evolution of emanation of from 1 to 5 times the maximum occurring with moderate working and at the temperature of spontaneous recovery. The temperature of maximum velocity of recovery was strongly indicated by this maximum evolution and has been studied in relation to the degree of working.—J. H. W.

†The Use of Thermionics in the Study of Adsorption of Vapours and Gases. Joseph A. Becker (*Trans. Faraday Soc.*, 1932, **28**, 148–158).—The value of thermionic emission phenomena in the study of evaporation, migration, and diffusion at metal and other surfaces is illustrated by numerous examples taken from recently published work.—A. R. P.

***On the Behaviour of Adsorbed Atoms.** J. Chariton, N. Semenoff, and A. Schalnikoff (*Trans. Faraday Soc.*, 1932, **28**, 169–176).—Deposits of cadmium from cadmium vapour of constant density can be obtained on surfaces which are maintained at temperatures above the so-called "critical temperature," provided that sufficient time is allowed. These deposits have a much more irregular structure than those obtained at temperatures below this critical value. It is suggested that condensation at the higher temperatures is due to the adsorptive effect of activated points in the surface on which condensation occurs. The subject is discussed at length from a theoretical point of view.—A. R. P.

***Adsorption and Solution of Gases by Metals.** Arthur F. Benton (*Trans. Faraday Soc.*, 1934, **28**, 202–218).—Curves are given showing the sorption at 50°–400° abs. and 0–76 cm. pressure of hydrogen, carbon monoxide, and nitrogen on copper powder (produced by reduction of the oxide by hydrogen at 115°–140° C.) and on iron produced by reduction of fused ferrosoferric oxide by hydrogen at 425°–450° C.); the sorption of hydrogen by nickel and of oxygen by silver is also briefly discussed. Analysis of the results shows that in all cases except those involving nitrogen three different processes occur, *viz.* physical adsorption, activated adsorption, and solution of the gas in the metal. In physical adsorption equilibrium is reached with great rapidity, the amount of adsorbed gas decreases uniformly with increasing temperature, and there is a discontinuous increase of adsorption with pressure. In activated adsorption the rate shows a rapid increase with temperature, and the heat of adsorption is much greater than for physical adsorption. In solution, final equilibrium is difficult to attain and hence no reliable conclusions can be reached as to the variation of solubility of gas with temperature and pressure. —A. R. P.

†**On Adsorption and Reflection Processes in the Interaction of Hydrogen and Metals.** K. F. Bonhoeffer and A. Farkas (*Trans. Faraday Soc.*, 1932, **28**, 242–247).—Temperature–adsorption curves for the adsorption of hydrogen by clean and by poisoned nickel, platinum, and iron surfaces indicate the possibility of hydride formation.—A. R. P.

†**On the Preparation of High Melting Metals by Thermal Dissociation of Their Compounds [—I].** A. E. van Arkel (*Metallwirtschaft*, 1934, **13**, 405–408).—An account is given of methods which have been developed in recent years for the preparation of the tungsten, tantalum, and zirconium groups of metals by thermal dissociation of their halides.—A. R. P.

†**Preparation of High Melting Metals by Thermal Dissociation of Their Compounds. II.—Properties of the Metals Obtained.** A. E. van Arkel (*Metallwirtschaft*, 1934, **13**, 511–514).—Titanium and zirconium prepared by sodium reduction of their chlorides are extremely brittle but, if purified by conversion into, and thermal dissociation of their iodides, they become highly malleable and ductile. On exposure to air the metals become coated with a passive oxide film and are then highly resistant to attack by alkalis and all acids except hydrofluoric. Thorium, uranium, vanadium, and chromium are also very ductile when prepared by thermal dissociation; tungsten, however, is ductile only when prepared in single-crystal form, and boron and silicon are always brittle. Zirconium and titanium nitrides can be prepared by heating the metal wire in an atmosphere of hydrogen, nitrogen, and the corresponding chloride of the metal; they have a sodium chloride type of lattice, but have the electrical properties of a metal, although they are very brittle. The systems titanium–TiN and zirconium–ZrN form continuous series of solid solutions similar to the zirconium–titanium and hafnium–zirconium systems with a minimum conductivity at about 50 atomic-% of the metal.—A. R. P.

†**Diffusion in Metals.** G. von Hevesy and W. Seith (*Metallwirtschaft*, 1934, **13**, 479–484).—From a critical review of recent work (20 references) it is con-

cluded that the diffusion of metals is governed principally by the melting point of the medium into which diffusion is taking place; if the melting points of the metals are close together differences in the rates of diffusion are determined by crystal–chemical magnitudes. Measured diffusion coeff. vary from 10^{-1} to 10^{-13} cm.^{2}/day, but by extrapolation of the temp.–coeff. curves to room temperature much wider differences are found, thus the rate of diffusion of lead is 10^{44} times as great as that of tungsten at room temperature. Extrapolation is based on a knowledge of the temperature coeff. (A) within a definite temperature range, and of the diffusion constant (D) at a definite temperature. The greater is A the greater is the heat of loosening (Q) of the crystal lattice, a magnitude which plays an analogous rôle in diffusion processes to the heat of activation in chemical reactions. Variation of D with temperature is given by the expression $D = A \cdot e^{-Q/RT}$ where T is the absolute temperature, and R is the gas constant. A is independent of the temperature, but is considerably affected by working the metal, variations in grain-size, the presence of impurities, &c.; Q, on the contrary, depends on the size of the diffusing atoms and those of the surrounding atoms, and is particularly small when diffusion takes place other than by place exchange.—A. R. P.

The Wear of Metals by Frictional Oxidation. On the Problem of the Cause of Fatigue Fracture. Max Fink (*Metallwirtschaft*, 1934, **13**, 623–625).—From a critical review of the mechanism of fatigue fracture and of frictional oxidation of metals subjected to rolling stresses in air, it is concluded that frictional oxidation plays an important part in fatigue fracture. Tests on the use of oil containing colloidal graphite as a lubricant in bearings indicate that fatigue failure can be avoided by excluding oxygen from the surface of the stressed metal.—A. R. P.

***Further Investigations on Catalysis by Liquid Metals.** E. W. R. Steacie and E. M. Elkin (*Canad. J. Research*, 1934, **11**, 47–52).—Cf. *Proc. Roy. Soc.*, 1933, [A], **142**, 457–465. A more detailed examination has been made of the kinetics of the methanol decomposition on solid and liquid zinc. The order of the reaction lies between zero and one-half on both liquid and solid metal. The heat of activation is approximately 30,000 cal./grm.mol. The reaction is mainly dehydrogenation. Unsuccessful attempts to investigate certain other reactions on liquid metals are described.—S. G.

The Theory of Optical Absorption of Alkali Metal Crystals. W. H. Watson (*Canad. J. Research*, 1934, **10**, 335–341).—The experimental results of R. W. Wood are compared with theory, using the model of free electrons perturbed by the periodic lattice potential. All relevant data are collected in a table in which it is seen that in sodium, potassium, rubidium, and cæsium the wave-length of the upper limit of the absorption band in the ultra-violet is proportional to the square of the lattice constant, while lithium occupies an anomalous position. The facts at present available do not permit a completely definite test of the absolute values of these wave-lengths given by the theory. —S. G.

***On the Relation Between the Thermal and the Mechanical Loosening of the Atomic Bonds in Metals.** F. Regler (*Ann. Physik*, 1934, [v], **19**, 637–664). —The X-ray lines of iron and silver are broadened by deformation, the broadening reaching at the point of fracture a maximum which is constant irrespective of the method of fracturing. In the case of silver this maximum is the same as that produced by heating the metal to incipient fusion.—v. G.

***Studies on the Transformation of Metals by Secondary Electron Emission.** Kazuma Hayakawa (*Kinzoku no Kenkyu*, 1934, **11**, (5), 219–234).—[In Japanese.] The object of this investigation was to study the transformation in metals by measuring the electron current excited by the thermionic current, or by measuring ionization current in a high vacuum tube at various temperatures. Each of these methods proved very successful. In the case of the allotropic change in iron and nickel these currents varied abruptly at the transformation points. In the case of the magnetic transformation in iron, nickel, and iron–nickel alloys the variation of the electron current or of the ionization current with increase in temperature is quite continuous, as was to be expected from the nature of the transformation; the same variation with respect to the course of electron current above the critical points changes its sign above and below the critical voltage of the exciting thermionic current. The existence of the critical voltage can be explained from the point of view of Richardson's structure electrons.—S. G.

***Electro-Capillary Phenomena and Wettability of Metals. II.—Measurement of Contact Angles on Platinum, Zinc, Silver, Gallium, and Thallium Amalgams.** A. Gorodezkaja and B. Kabanov (*Zhurnal Fizicheskoy Khimii* (*J. Phys. Chem.*), 1933, **4**, (5), 529–537; also *Physikal. Z. Sowjetunion*, 1934, **5**, 418–431).—[In Russian.] Contact-angles of bubbles of hydrogen on metals in electrolytes have been measured at different degrees of polarization. Curves for σ–ϕ are given for liquid gallium and thallium amalgam and for solid platinum, zinc, silver, and mercury-coated platinum. The potentials corresponding with the maximum contact-angle (A) and with the maximum on the electro-capillary curve (B) are as follows:

Metal.	Solution.	A.	B.
Mercury	N-Na$_2$SO$_4$ (acid)	0·56	0·48
Platinum	,, ,,	0·0	...
Platinum + mercury . . .	0·1N-H$_2$SO$_4$	0·43	0·48
Silver	N-Na$_2$SO$_4$ (acid)	0·3	...
Gallium	N-KCl + N-HCl	1·2	0·9
Thallium amalgam . . .	N-Na$_2$SO$_4$ (acid)	0·95	0·93

For platinum and silver the maximum of the contact-angle curve lies close to the point of zero charge obtained by the adsorption method.—N. A.

***Activity of Thin Metal Films.—I.** P. Dankov (*Zhurnal Fizicheskoy Khimii* (*J. Phys. Chem.*), 1933, **4**, (3), 326–333).—[In Russian.] Thin films of nickel, iron, and platinum ($\sim 10^{-6}$ cm.) of ultramicroscopic structure have been obtained by evaporating and condensing the metals *in vacuo*. These films have a high catalytic activity in the hydrogenation of ethylene. Nickel less than 2 μμ thick is inactive; the activity then increases rapidly for thicknesses between 2 and 30 μμ, after which the increase is slight. The activity of nickel as catalyst is only slightly affected by foundations of glass, brass, thin paper, and mica. It "poisons" comparatively slowly, but loses all activity on contact with the atmosphere. In examining the magnitude of the activity per unit mass of catalyst, nickel is found to show in relation to film thickness a sharp maximum in the region of 15–20 μμ, as well as a parallelism between the values obtained and the anomalous electrical conductivities of thin metal films.
—N. A.

***Activity of Thin Metal Films. II.—Oxidation of Sulphur Dioxide on Platinum.** P. Dankov, I. Joffe, A. Kochetkov, and I. Perevezenzev (*Zhurnal Fizicheskoy Khimii* (*J. Phys. Chem.*), 1933, **4**, (3), 334–342).—[In Russian.] Thin films of platinum and vanadium pentoxide have been obtained by evaporation and condensation *in vacuo* on a glass or iron surface (platinum only), and by cathodic sputtering of platinum on to iron. The rate of oxidation of sulphur dioxide to sulphur trioxide at 450° C. with a gas speed of 0·5 litres/hr. has been determined for the various catalysts. Thin films of platinum and vanadium pentoxide have a feeble activity several times less than that of platinum on platinized asbestos. The low activity of thin platinum films on glass and iron is due to the recrystallization of the film during the oxidation process. Platinized asbestos obtained by condensing platinum vapour *in vacuo* is as highly active as that prepared by the usual method.—N. A.

***Activity of Thin Metal Films. III.—Investigation of Silver, Zinc, and Cadmium.** P. Dankov and D. Dobichin (*Zhurnal Fizicheskoy Khimii* (*J. Phys. Chem.*), 1933, **4**, (3), 343–345).—[In Russian.] Thin films of silver are inactive in the region between 15° and 100° C., whether obtained by dipping in molten silver or by electrolysis from a cyanide bath. Thin films of cadmium and zinc, or mixtures thereof obtained by the simultaneous evaporation of both metals, do not promote hydrogenation of ethylene, probably owing to the physical structure of the metals; their low recrystallization temperature causes the formation of large crystals at room temperature, whereby the active surface area is diminished.—N. A.

The Science of Sealing Metals to Glass. Albert W. Hull (*Phys. Rev.*, 1934, [ii], **45**, 285).—Abstract of a paper read before the American Physical Society. The differential thermal expansion between glass and metal has been measured with great care for all the common sealing materials and for a number of new alloys and glasses. Typical combinations were then tested, after annealing at definite temperatures, for strength and strain, and the results compared with predictions based on the expansion measurements. A new alloy is described, the expansion of which matches that of a particular glass over the entire range from zero to the softening point. With this combination of glass and metal it is possible to test the hypothesis, which is basic to a science of seal making, that properly annealed seals will be strain-free to exactly the degree indicated by the expansion data. The results confirm this hypothesis.—S. G.

***On Non-Conducting Modifications of Metals.** J. Kramer (*Ann. Physik*, 1934, [v], **19**, 37–64).—Thin metal films produced by evaporation of metals *in vacuo* and by cathodic sputtering have only about one-tenth the electrical conductivity of the compact metal. Debye photographs show these films to be amorphous. Their conductivity decreases slightly on exposure to light, and on heating returns to the normal value when the metal becomes crystalline; this occurs at a temperature which is characteristic for every individual metal. —v. G.

The Thermal Conductivity of Metals. A. Schulze (*Russko-Germanskii Vestnik Nauki Tekh*, **1932**, (11), 35–48; *Chem. Zentr.*, 1933, **104**, II, 1850; *C. Abs.*, 1934, **28**, 6040).—Thermal conductivity and its relation to temperature are discussed for metals in general, as well as data for some of the more important metals.—S. G.

***Theory of Metals.** R. Peierls (*Z. Physik*, 1934, **88**, 786–791).—P. replies to Kretschmann's criticism of his theory of metallic conduction (cf. *Met. Abs.*, this volume, p. 484, and following abstract).—J. S. G. T.

***The Resonance Condition and the Acceleration of Electrons in Bloch's Theory of Electrical Conduction.** Erich Kretschmann (*Z. Physik*, 1934, 88, 792–799).—K. replies to Peierl's criticism (see preceding abstract).—J. S. G. T.

***New Experiments on Metallic Conduction.** E. Weber (*Phys. Rev.*, 1934, [ii], **45**, 740).—Abstract of a paper read before the American Physical Society. Previous investigations on the current distribution in a long copper bar 4 in. wide and $\frac{1}{32}$ in. thick have been continued and lead to several new results. Given the measured distribution of the electric field strength over the entire bar, a weak magnetic field applied perpendicular to the flow of current (and heat) produces changes in this distribution in longitudinal as well as transverse direction. Attempts are made to explain these changes by the familiar thermoelectric and thermomagnetic effects on the basis of the Sommerfeld–Franck theory, but fail to be satisfactory. The effects measured are of the order of $3 \cdot 10^{-5}$ v./cm. down to 10^{-7} v./cm. In addition a transient state of the readjustment of the current distribution after changes of the applied voltage has been observed which may last as long as 20 minutes and may indicate that in addition to electronic flow some slowly adaptable phenomenon is involved in metallic conduction.—S. G.

Superconductivity.—I. C. J. Gorter and H. Casimir (*Physica*, 1934, **1**, 306–320; *C. Abs.*, 1934, **28**, 4954).—On the basis of magnetic induction $B = 0$ in the superconductive state it follows from thermodynamic considerations that the specific heat is independent of the external magnetic field H. For a magnetic field threshold value H_2 (at temperature T_2) application of the second law leads to: $(dH_2/dT_2)^2 = (4\pi d(c_s - c_n)/T_0)$ where d is the density, c_s and c_n the specific heats of superconductive and normal states, respectively, and T_0 the transition temperature without magnetic field (cf. Ehrenfest, *Proc. K. Akad. Wet. Amsterdam*, 1933, **36**, 153–157). This equation is verified by the experiments on tin and thallium. It is evident that the transition process is reversible in such manner that persisting currents are started around parts of a body which became superconducting reducing B within them to zero. A few partly unexplained results are: at times regions in the object can exist with B not equal to 0 even in the absence of an external magnetic field; possibly this is due to superconducting rings. Furthermore, the mechanism of the gradual disturbance of superconductivity requires additional investigation.—S. G.

†**Ferromagnetic Crystals.** F. Bitter (*Metallwirtschaft*, 1933, **12**, 720–722, 735–739).—A theoretical and mathematical discussion on recent work on the nature of ferromagnetic phenomena in iron and nickel.—A. R. P.

The Physical Significance of Ferromagnetism. R. Sanger (*Bull. Assoc. Suisse Elect.*, 1934, **25**, 568–570).—An amplification of an article on problems of ferromagnetism (*Met. Abs.*, this volume, p. 230) dealing mainly with the explanation of dia-, para-, and ferromagnetism and with the magnetization curve and the making of permanent magnets.—P. M. C. R.

On the Distribution of Ferromagnetism Among the Metals. David R. Inglis (*Phys. Rev.*, 1934, [ii], **45**, 128).—Abstract of a paper read before the American Physical Society.—S. G.

***On the Magnetization of Imperfect Crystals.** Francis Bitter (*Phys. Rev.*, 1934, [ii], **45**, 742).—Abstract of a paper read before the American Physical Society.—S. G.

The Approach to the Theoretical Magnetization Curve. T. D. Yensen (*Phys. Rev.*, 1934, [ii], **45**, 743).—Abstract of a paper read before the American Physical Society. Magnetization curves for iron, iron–silicon, and iron–nickel alloys show that the approach of the theoretical curves, based on the Langevin–Weiss theory, is a function not only of lattice orientation but also of the purity of the metal or alloy.—S. G.

II.—PROPERTIES OF ALLOYS

(Continued from pp. 486–495.)

***Tensile Strength and Hardness of Various Aluminium Alloys at Elevated Temperature.** A. von Zeerleder, —— Bosshard, and —— Irmann (*Z. Metallkunde*, 1933, **25**, 293–299; and (abstract) *Met. Ind.* (*Lond.*), 1934, **44**, 296).—The tensile strength, elongation, and Brinell hardness of various grades of aluminium and of aluminium rolling and casting alloys have been determined at temperatures up to 450° C. after various heat-treatments, and the effects of heating for periods of 15 minutes to 300 days at different temperatures have been determined. The original must be consulted for details of the results.—B. Bl.

***The Influence of the Cross-Sectional Area of Cast Aluminium Alloys.** M. von Schwarz [with A. Evers] (*Z. Metallkunde*, 1933, **25**, 269–274).—The tensile strength, yield-point (0·001% limit), bending strength, and Brinell hardness of the following alloys have been determined: (*a*) aluminium 84, zinc 14, copper 2%; (*b*) aluminium 92, copper 8%; (*c*) aluminium 83, zinc 13, copper 3·8%, other hardening constituents 0·2%; (*d*) aluminium 90, copper 9·8, other hardening constituents 0·2%. The test-pieces were taken from the outside and middle of cast ingots of various dimensions.—B. Bl.

***Aluminium–Copper Alloys.** A. Vivanti (*Alluminio*, 1934, 3, 268–280).—Long vertical ingots have been prepared in which the composition varied from pure copper at one end to pure aluminium at the other, and the structure has been examined from top to bottom after annealing at 1120°, 950°, and 850° C. The results are shown in photographs of etched sections of the ingot and are discussed with reference to Stockdale's equilibrium diagram of the copper–aluminium system. Several unexpected features in the arrangement of the phases indicate that some modifications are required in the equilibrium diagram.—G. G.

***The Age-Hardening of Copper–Aluminium Alloys with a Copper Content Over 5% and the Influence of Additions of Manganese, Nickel, Titanium, and Vanadium Alone or Together.** H. Bohner (*Z. Metallkunde*, 1933, 25, 299–305).—Binary aluminium alloys with about 6% copper (*i.e.* just above the solid solubility limit) have better mechanical properties than similarly heat-treated alloys with lower copper content. Quenching and ageing temperatures, and time of ageing have an appreciable effect on the mechanical properties; storage for several days at room temperature and a steady increase of temperature during ageing are recommended. The strength is increased by addition of titanium or manganese or both together. Addition of nickel has a deleterious effect not only on the binary copper alloy but also on ternary alloys containing titanium or vanadium; the latter has no effect on the mechanical properties alone and its effect on the ageing is strongly dependent on the previous mechanical treatment. Mild forms of mechanical treatment increase the yield-point without appreciably affecting the tensile strength and elongation. Coating the alloys with pure aluminium improves the bending properties and capacity for plastic deformation.—B. Bl.

***The Temper-Hardening of Alloys. VIII.—[Photo]-micrographic Studies on the Tempering of Copper–Aluminium Light Alloys.** Denzo Uno and Yoshizō Murakami (*Kōgyō Kwagaku Zasshi* (*J. Soc. Chem. Ind. Japan*), 1934, **34**, (4); *Brit. Chem. Abs.*, **1934**, [B], 723).—[In Japanese, with German summary in supplemental binding, pp. 176–177.] Photomicrographs of copper–aluminium alloys containing 4% copper show that the degree of hardening depends on the extent to which the crystallites of $CuAl_2$ are dispersed uniformly throughout the solid.—S. G.

***Constitution of Iron-Rich Iron–Aluminium–Carbon Alloys.** F. R. Morral (*Iron Steel Inst. Advance copy*, **1934**, Sept., 1–10).—Micrographic and X-ray examination of ternary alloys containing up to 28% aluminium and up to 3·6% carbon have proved the existence of the following phases: (*a*) α-iron solid solution with random atomic distribution or with Fe_3Al or FeAl superstructures, (*b*) austenite with up to 1·5% carbon and 6% aluminium at 1000° C., (*c*) a hard brittle ferromagnetic phase ε with a cubic lattice containing 4 atoms in the unit cell, the aluminium atoms occupying the corners of the cube and the iron atoms the centre of the faces. Phase ε corresponds with Fe_3Al but it contains about 4% carbon. With more than 19% aluminium all the aluminium enters the α-iron of the FeAl type and graphitization of the carbon is complete.—A. R. P.

***The Physical Properties of Iron–Aluminium Alloys.** C. Sykes and J. W. Bampfylde (*Iron Steel Inst. Advance copy*, **1934**, Sept., 1–22).—Good castings of aluminium–iron alloys may be obtained from induction-furnace melts by the use of moulds dressed with chlorinated pitch or by addition of carbon tetrachloride or trichlorethylene as the metal is being cast to convert the alumina film into volatile aluminium chloride. Alloys with 0·5% aluminium can be cold-rolled and alloys with 5–16% aluminium can be hot-worked but are very brittle when cold. The tensile strength increases to a maximum with 5% aluminium and the elongation decreases suddenly from 40 to 1% as the aluminium is increased from 5 to 7%. The impact values are good up to 3·5% aluminium, but are considerably affected by the previous heat and mechanical treatment, probably owing to variations in the carbide distribution thereby produced. Alloys with up to 12% aluminium become quite ductile at temperatures above 400° C., and can be drawn into wire by a stepped heat-treatment to produce grain-refinement; mechanical properties of wires (0·043 in. in diameter) of alloys with 1·7–12·2% aluminium are tabulated. Curves showing the mean coeff. of linear expansion at various temperatures as a function of the composition show a well-marked inflection at 12% aluminium. The density of aluminium–iron alloys is greater than that calculated by the mixture rule, the deviation increasing with increasing aluminium content; the electrical resistance at constant temperature between 20° and 800° C. is a linear function of the aluminium content from 2 to 11%. The resistance to corrosion of alloys with about 16% aluminium is almost equal to that of stainless steel, but the resistance to scaling at high temperatures is very much less.—A. R. P.

***On Spherical Precipitated Aluminium–Iron–Silicon Eutectic in Pure Aluminium.** H. Röhrig and E. Köpernick (*Metallwirtschaft*, 1934, **13**, 591–593; and (translation) *Light Metals Research*, 1934, **3**, 137–138).—The microstructure of chill-cast aluminium of a purity greater than 99·5% shows small spherical inclusions which under a high power are seen to consist of a ternary iron–silicon–aluminium eutectic. These inclusions never appear in sand-castings or in slowly-cooled alloys. Quick cooling of an alloy of aluminium with 1·9% silicon and 1·1% iron produces a microstructure containing needles of $Al_6Fe_2Si_3$ and small inclusions of silicon, but if this alloy is held at 600°–620° C. for some time and quenched these disappear and are replaced by spherical globules of the ternary eutectic; slow cooling after annealing results in a breakdown of the eutectic. Hence it is concluded that the eutectic is formed in the range between solidus and liquidus and remains undecomposed only on rapid cooling. When the alloy contains a high content of silicon and iron the solidification range is so great that the normal rate of solidification is insufficient to maintain the original spherical form of the inclusions.—A. R. P.

***Aluminium–Lithium Alloys.** S. Bernadziekiewicz and W. Broniewski (*Prace Zakładu Metallurgicznego Politechniki Warsawskiej*, 1933, **3**, 102–112).—[In Polish, with French summary.]—The limit of solid solubility of lithium in aluminium is 3·4 (12 atoms) % in the cast state and 2·8 (10 atoms) % after annealing; alloys with more than 2·8% lithium can therefore be age-hardened. Thus the alloy with 3·3% lithium when aged at 100° C. after quenching from 550° C. has a tensile strength of 25·8 kg./mm.^{2}, with an elongation of 26% and a hardness of 59 (Brinell). Characteristic microstructures are shown and curves are given showing the change in many physical and electrical properties with increase in the lithium content.—A. R. P.

***The Solid Solubility of Magnesium in Aluminium at Different Temperatures.** P. J. Saldau and L. N. Sergeev (*Metallurg* (*Metallurgist*), **1934**, (4), 67–70).—[In Russian.] From the microstructure of quenched alloys the following values for the solid solubility of magnesium in aluminium have been obtained: at 435° C., 14·08%; 370° C., 10·02%; 336° C., 8·36%; 285° C., 6·82%; 196° C., 4·74%; after slow cooling, 3·08%.—N. A.

***Equilibrium Relations in Aluminium–Nickel Alloys of High Purity.** William L. Fink and L. A. Willey (*Metals Technology*, **1934**, (Sept.), *A.I.M.M.E. Tech. Publ.* No. 569, 1–11).—An investigation of the system up to 18% nickel by thermal and micrographic methods using 99·985% aluminium and 99·38% electrolytic nickel has shown that the eutectic between NiAl, and aluminium occurs at 639·9° C. and 5·7% nickel and that the solid solubility of nickel in aluminium decreases from 0·05% at the eutectic temperature to 0·005% at 500° C. Alloys with more than 0·01% nickel can be age-hardened by quenching from 625° C. and ageing for 8–20 hrs. at 265° C., the maximum effect being obtained with 0·05% nickel.—A. R. P.

***Solubility of Silicon in Aluminium in the Solid State at Different Temperatures.** P. J. Saldau and M. V. Danilovitsch (*Legkie Metalli* (*Light Metals*), **1932**, (9), 12–19).—[In Russian.] 12 alloys containing from 0·17 to 2·12% silicon were examined micrographically after annealing at 300°, 400°, 480°, and 560° C., either for 10 days with slow cooling or for 14 days followed by quenching. The results showed the solubility of silicon in aluminium to be less than 0·17% at 15°–300°, 0·3% at 400°; 0·65% at 480°; and 1·25% at 560° C. At the eutectic temperature (570° C.) the extrapolated value is 1·32%.—D. N. S.

***Effects of Alloying Processes on the Electrical Resistance of Aldrey-Type Alloys.** Sakichi Kishino (*Kōgyō Kwagaku Zasshi* (*J. Soc. Chem. Ind. Japan*), 1934, **34**, (4); *Brit. Chem. Abs.*, **1934**, [B], 723).—[In Japanese, with English summary in supplemental binding, pp. 175–176.] Alloys were made (*a*) by adding silicon and magnesium separately to molten aluminium, and (*b*) by adding them as the compound Mg_2Si. The sp. resistance of alloys (*a*) and its increase on quenching at 510° C. are greater than for alloys (*b*). The rate of increase varies linearly with the [Mg_2Si]. No change in resistance due to quenching occurs with less than 0·475% Mg_2Si, whence it is concluded that 0·475% is the maximum limit of solubility of Mg_2Si at room temperature. After annealing, all samples have nearly the same resistance.—S. G.

Metallography and Properties of Metals [γ–Silumin]. Anon. (*Metallwirtschaft*, 1934, **13**, 230).—A summary of the mechanical and physical properties of normal and hardenable γ–Silumin.—v. G.

***On the Nature of Solid Solutions of Aluminium in Silver.** N. Ageew and D. Shoyket (*Metallurg* (*Metallurgist*), **1934**, (3), 38–42).—[In Russian.] The work of Phelps and Davey (*J. Inst. Metals*, 1933, **53**, 129) is discussed and an exact measurement has been made of the parameter of the solid solution of the aluminium in silver. The calculated density is based on a simple replacement of atoms.—N. A.

***The Preparation of Titanium–Aluminium Alloys.** S. S. Stroev and S. G. Glazunov (*Tehnika Vosdushnogo Flota* (*Technics of the Aerial Navy*), **1933**, (5), 49–58).—[In Russian.] For the preparation of alloys containing 2–5% titanium, a dry, finely-ground mixture of titania and cryolite is thoroughly stirred into aluminium (about 50 grm.) heated in a graphite or magnesite crucible to 1000°–1050° C.; a vigorous reaction at once occurs, the temperature rising to 1250°–1300° C. Alloys containing a high proportion of titanium (12–14%) are made by placing a mixture of titania, cryolite, and potassium chlorate with aluminium shavings into an empty crucible preheated to 1000°–1100° C.; after the first rigorous reaction has subsided (increasing the temperature to 1300°–1370° C.) more of the charge may be fed in slowly. The pouring temperature must not be below 1000° C. Loss of aluminium by burning is 25–30% of the shavings. The alloys most suitable for industry are those with 3–5% titanium, with or without copper. A method of analysis of titanium–aluminium alloys is given. 18 references to the literature are given.—N. A.

On Aluminium Alloys of High Purity. E. Söhnchen (*Metallwirtschaft*, 1933, **12**, 267–268, 593–594).—A review of recent American work on the aluminium–copper–magnesium, aluminium–copper–magnesium silicide, aluminium–cobalt, and aluminium–zinc alloys made with high-purity aluminium (99·95–99·98%). Recent American work on alloys of chromium and manganese with high purity aluminium is briefly described.—A. R. P.

On the Cadmium–Lithium Alloys. A. Baroni (*Z. Elektrochem.*, 1934, **40**, 565).—A polemic against Zintl and Schneider (*Met. Abs.*, this volume, p. 178). B. claims that the compound, $LiCd_3$, stated by Z. and S. to have a simple hexagonal structure, has really a complicated cubic structure. Z. and S. allot a cubic lattice of the type NaTl, with $a = 6{\cdot}687$ A., while B. claims that it has a cubic structure of the type CsCl, with $a = 3{\cdot}32$ A. From X-ray observations, Z. and S. allot a cubic face-centred lattice to the compound Li_3Cd, but B. states that this compound is formed by slow cooling and is not stable, but decomposes into LiCd and Li.—J. H. W.

Investigations on the Technical Production of Calcium–Silicon Alloys. Robert Weiner (*Z. Elektrochem.*, 1934, **40**, 624–629).—The conditions under which the alloy $CaSi_2$ can be prepared from calcium carbide, silica, and carbon are described.—J. H. W.

Curie Point of Ferro–Cerium. G. Rassat (*Compt. rend.*, 1932, **194**, 1153; and (abstract) *Technique moderne*, 1932, **24**, 447; *Brit. Chem. Abs.*, **1932**, [A], 562).—Ferro–cerium containing 27·5% iron loses its magnetism at about 40° C.; samples containing about 32% iron do not cease completely to be magnetic up to the temperature of ignition, indicating the presence of more than one substance.—I. M.

On Ferromagnetic Platinum–Chromium and Iridium–Chromium Alloys. E. Friederich (*Tech. wiss. Abhandl. Osram-Konzern*, 1934, **3**, 130).—See *J. Inst. Metals*, 1932, **50**, 542. In the original paper, the title has been erroneously given as platinum–iridium alloys instead of iridium–chromium alloys.—v. G.

***A New Magnetometer for Crystal Ferromagnetism and Its Application to Iron Cobalt Alloy Crystals.** L. W. McKeehan and J. W. Shih (*Phys. Rev.*, 1934, [ii], **45**, 742).—Abstract of a paper read before the American Physical Society. Some iron–cobalt crystals in the body-centred range (at room temperature) have been examined. The easy direction of magnetization, [100] at the iron end of the series, is replaced by [111] at a composition, not yet accurately fixed, lying between 30 and 70% cobalt.—S. G.

***On the Equilibrium Diagram of the System Cobalt–Tungsten Carbide.** A. M. Korolkow and A. M. Lavler (*Metallurg* (*Metallurgist*), **1934**, (2), 53–55).—[In Russian.] Alloys with 1–95% of tungsten carbide have been studied. The limit of solid solubility of tungsten carbide in cobalt is about 15% and the eutectic contains 35% WC. Phase X containing about 60% WC is formed by a peritectic reaction.—N. A.

***On an Intermediate Phase in the Hypereutectoidal Copper–Aluminium Alloys. Preliminary Note.** G. Kurdjumov and T. Stelletzky (*Metallwirtschaft*, 1934, **13**, 304).—Rapid quenching of copper alloys with 13·5–15% aluminium produces a structure showing lines of a new phase γ' in the X-ray photograph. Quenching from temperatures at which β is stable produces solely γ', from above 800° C. a mixture of γ and γ', and from between the eutectoid line and 670° C. a mixture of γ and β'; these results show that the formation of β' and γ' depends on the Al content of the alloy at the quenching temperature and that the formation of both phases is due to the relatively slow rate of diffusion of aluminium in copper. The γ'-phase is formed at below 300° C. since quenching in a salt-bath at this temperature fails to produce it.—A. R. P.

†A Contribution to the Interpretation of the Phenomena in β-Aluminium–Bronze. U. Dehlinger (*Metallwirtschaft*, 1934, **13**, 205–206).—Recent work on the nature of the β'-phase in aluminium–copper alloys is reviewed, and the results are shown to be in accordance with the assumption that this phase is of an unstable martensitic nature and that its formation is due to the relatively slow rate of diffusion of the constituent atoms at temperatures in the region of 300° C.—A. R. P.

***On the Transformations of the β-Phase of Copper–Aluminium Alloys. Preliminary Note.** E. Kaminsky, G. Kurdjumov, and W. Neumarx (*Metallwirtschaft*, 1934, **13**, 373).—The transformation $\beta \longrightarrow \alpha + \gamma$ is easily suppressed and on cooling β alloys in air the β'-phase is obtained, the cooling curve showed two well-marked inflections at 500° and 380° C., respectively; on reheating a less well-defined inflection is obtained at 450° C. and a well-defined inflection at 525° C. If the specimen is kept at 450° C. for a few minutes during cooling the second inflection occurs at 250° C. on cooling and at 360° C. on heating. These inflection points are due to the transformation of β (random distribution) into β_1 (ordered distribution) then into β' on cooling. Annealing at 450° C. produces $\alpha + \gamma$ and the effect at 300° C. disappears. Heating curves show that it is possible to convert β' into β_1 then into β without formation of $\alpha + \gamma$. The $\beta \longrightarrow \beta_1$ and $\beta_1 \longrightarrow \beta'$ transformations take place at high speed and cannot be repressed by quenching, the $\beta_1 \longrightarrow \beta'$ transformation corresponding with the austenite → martensite transformation in steel.—A. R. P.

***An Investigation of Copper–Beryllium Alloys.** A. P. Smiriagin and A. V. Belova (*Zvetnye Metally* (*The Non-Ferrous Metals*), **1933**, (5), 83–97; (6), 111–116; *C. Abs.*, 1934, **28**, 5022).—[In Russian.] The purpose of the investigation was to study in detail the mechanical workability and mechanical properties of copper–beryllium alloys, and particularly the variation of yield-strength with their capacity for hardening. A series of melts was made with beryllium contents varying from 0·1 to 3·0%. Cast samples were heated for various periods of time at 300° C. and either quenched in water or cooled in the furnace. Slowly-cooled alloys containing 2–3% beryllium attain considerable hardness within 2 hrs. at 300° C.; the quenched alloys within 4 to 6 hrs. In all cases the maximum hardness was obtained in 8 to 10 hrs. The tensile strength of cast alloys increases with beryllium content and is accompanied by a decrease in elongation, the average yield-strength being about half the tensile strength. In the hardened alloys, however, the yield-strength increases greatly and practically coincides with the tensile strength. Samples of alloys containing 1–3% beryllium were cold- and hot-rolled from 5 to 2 mm. in thickness in 0·5 mm. steps. For hot-rolling the samples were heated to 700° C. All samples rolled satisfactorily with the exception of the 3% alloys, which could not be cold-rolled. Cold-working increases the tensile strength considerably with the elongations maintained at 50 to 60%. The hardness increases to varying degree with increase in beryllium content, depending on the mechanical treatment. The changes in mechanical properties were correlated with the structure of the alloys. The cast alloys showed considerable tendency to recrystallization. The microscopic examination confirmed the corrections introduced into the copper–beryllium diagram by Masing and Dahl (*J. Inst. Metals*, 1929, **42**, 438, 440).—S. G.

***Physiochemical Researches on Solid Solutions of Gold and Copper.** N. S. Kurnakow and N. W. Ageew (*Izvestia Instituta Fiziko-Khimicheskogo Analisa* (*Ann. Inst. anal. phys.-chim.*), 1933, **6**, 25–46; *Chem. Zentr.*, 1934, **105**, II, 1083).—[In Russian.] The decomposition of solid solutions of copper and gold into AuCu and $AuCu_3$ below 425°–450° C. has been demonstrated by measurements of the electrical resistance and its thermal coeff. at temperatures up to 600° C. Dilatometric measurements show that the solid solution range of $AuCu_3$ extends from 22 to 40 atomic-% gold and that of AuCu from 42·2 to 70 atomic-% gold. The formation of the compounds is accompanied by a sharp contraction in volume which does not appear when the alloys are quenched.—A. R. P.

***Electrical Properties of Dilute Solid Solution Alloys. III.—Resistance of Copper and Gold Alloys. Regularities in the Increase in Resistance.** J. O. Linde (*Ann. Physik*, 1932, [v], **15**, 219–248).—The increase in the specific electrical resistance of copper produced by addition of 1 atomic-% of various metals is as follows (in microhm. cm.): nickel 1·25, cobalt 6·4, iron 9·3, manganese 2·83, silver 0·14, palladium 0·89, rhodium 4·40, gold 0·55, platinum 2·15, iridium 6·1, zinc 0·335, gallium 1·40, germanium 3·75, arsenic 6·8, cadmium 0·21, indium 1·10, tin 2·85, antimony 5·45, mercury 1·00. The corresponding figures for additions to gold are: manganese 2·41, chromium 4·25, titanium 14·4, zinc 0·96, gallium 2·2, germanium 5·2, cadmium 0·64, mercury 0·41. The figures show that the solid solubility of ruthenium, osmium, and molybdenum in copper is practically nil. The results are discussed in comparison with those previously obtained with silver and gold (*J. Inst. Metals*, 1932, **50**, 15; 1933, **53**, 15).—v. G.

***The System Copper–Lead.** Willi Claus (*Metallwirtschaft*, 1934, **13**, 226–227).—The contradictory statements which have been made about the formation of conjugate layers in copper–lead alloys with 40–95% lead are explained as follows: on cooling the liquid below 1600°–1700° C. segregation occurs, but the two melts, copper-rich and lead-rich, remain emulsified in one another; only below 999° C. does the melt separate into two layers. Conversely, on heating a thorough dispersion of the two metals in one another occurs only above 1300° C.—v. G.

***On the Influence of a Nickel Addition on the Solubility and Precipitation-Hardening of Silver–Copper Alloys.** H. Pfister and P. Wiest (*Metallwirtschaft*, 1934, **13**, 317–320; and (summary) *Metallurgist* (Suppt. to *Engineer*), 1934, **10**, 154–156).—Addition of 1% of nickel reduces the solid solubility of silver in copper by about 0·1% at 400° C. and by 1% at 770° C. The precipitation-hardening of quenched alloys of copper with 5 and 7·5% silver and 1% nickel has been followed and certain differences between the behaviour of ternary and binary alloys have been observed.—v. G.

***Transcrystalline Structure in Tin–Bronze.** A. Belova (*Zvetnye Metally* (*The Non-Ferrous Metals*), **1933**, (4), 94–101; *C. Abs.*, 1934, **28**, 5025).—[In Russian.] B. investigated the influence of temperature on the structure and mechanical properties of bronze. Higher casting temperatures produce larger crystals and favour columnar crystallization. Increasing the temperature of the mould at constant casting temperature produces large grain but hinders the columnar crystallization. Overheating the molten metal promotes columnar crystallization even if the casting temperature is sufficiently low. Optimum structures and mechanical properties can be obtained by selecting proper casting and mould temperatures, the degree of superheating, and the time of cooling to, and holding at, the casting temperature.—S. G.

***On the Structure of Copper–Zinc Alloys.** W. Broniewski and J. Strasburger (*Prace Zakładu Metallurgicznego Politechniki Warsawskiej*, 1933, **3**, 3–26).—[In Polish, with French summary.] Curves are given showing the electrical resistance, potential, thermoelectric power, and coeff. of thermal expansion as functions of the atomic composition at 20° C. of copper–zinc alloys which have been homogenized by annealing at 400° C. for 1000–3000 hrs. Practically all the curves show well-marked inflections at the compositions CuZn, $CuZn_2$, and $CuZn_6$ but no inflection at Cu_2Zn_3, which appears therefore to represent simply the limit of solid solubility of Cu in $CuZn_2$. The curves of electrical resistance and of thermal expansion display irregularities in the region of zinc-rich solid solution; these may be due to an allotropic modification.—A. R. P.

***Investigations on the Heat Tone and the Change of Some Physical Properties with the Transformation of β-Brass.** H. von Steinwehr and A. Schulze (*Z. Metallkunde*, 1934, **26**, 130–135).—Abridged from *Physikal. Z.*, 1934, **35**, 385–397. See *Met. Abs.*, this volume, p. 490.—M. H.

Bursting Strengths of Cold-Drawn Brass Tubes. J. Fox (*Mech. World*, 1931, **90**, 454–457; *Bull. B.N.F.M.R.A.*, 1932, (**40**), 8).—Special reference is made to internal stresses, which are not found to have a serious effect on the bursting strength of cold-drawn tubes.—S. G.

***A Study of Methods of Production of Graphitized Metals and Alloys [Copper; Copper Alloys; Babbitt].** M. P. Slavinsky and A. S. Tumarev (*Metallurg* (*Metallurgist*), **1933**, (4–5), 70–91).—[In Russian.] Experiments on the production of graphitized copper and copper alloys by blowing coal-gas (methane, 48·2%) into the molten metal and by addition of aluminium carbide have given negative results. The best results have been obtained by pressing mixtures of powdered bronze (10 and 20% tin) and graphite into shape under a load of 3000 kg./cm.², and sintering at 850°–950° C. (10% tin–bronze) or at 800°–900° C. (20% tin–bronze). The Brinell hardness decreases from 65 to 6 with increasing graphite content. The resistance to compression is between 3·7 and 24·2 kg./mm.², according to the graphite content. Similar tests have also been carried out with copper, Babbitt metal, "aluminium–bronze," and brass.—N. A.

Tungum [Brass] Alloy. B. C. Laws (*Met. Ind.* (*Lond.*), 1934, **44**, 605–606). —The mechanical properties of the alloy are tabulated.—J. H. W.

The Use of Cadmium to Simplify the Construction of Cast Gold Crowns. Joseph C. Polenaar (*S. African Dental J.*, 1934, **8**, 200–204; *Tijdschrift voor Tandheilkunde*, 1934, **14**; and (abstract) *Dental Cosmos*, 1934, **76**, 1119).—S. G.

***Composition of Grids for Positive Plates of Storage Batteries as a Factor Influencing the Sulphation of Negative Plates.** G. W. Vinal, D. N. Craig, and C. L. Snyder (*U.S. Bur. Stand. J. Research*, 1933, **10**, 795–808; *Research Paper* No. **567**; and *World Power*, 1933, **20**, 318–323).—The conditions under which antimony, a constituent of battery grids, may produce detrimental effects in the operation of storage batteries have generally been regarded as exceptional. Recent experiments have shown, however, that the corrosion of the grids of positive plates, in normal operating conditions, may liberate antimony from the alloy in sufficient amounts to affect the operation and life of the negative plates. Two series of cells were prepared and operated in the laboratory to study the effect of varying the composition of the grids for positive plates. The first series included all cells having lead–antimony grids and the second included cells having positive grids containing various % of cadmium. Data on the capacity of these cells during 115 cycles are given, together with measurements of plate potentials, rate of sulphation, and the chemical analysis of the active material of negative plates for antimony.—S. G.

***On the Miscibility of Sulphides of Lead, Copper, and Iron with Metallic Lead in the Liquid State.** W. Leitgebel and E. Miksch (*Metall u. Erz*, 1934, **31**, 290–293).—Addition of lead to molten iron and copper sulphides reduces the solidification point to 1000° C. with 30% lead, and 1060° C. with 7% lead, respectively; further addition of lead results in the formation of a second liquid phase. No such separation occurs in the lead–lead sulphide system, but addition of less than 5% of iron or copper sulphides to a 1 : 1 mixture of lead and lead sulphide causes separation into two layers. The equilibria in the ternary systems of lead with two of the sulphides—lead, copper, and iron—are shown diagrammatically and their metallurgical significance is discussed. —A. R. P.

Tellurium–Lead. Anon. (*Dutch Boy Quarterly*, 1934, **12**, (2), 9–11).—A brief account of the properties and applications of tellurium–lead. See also *J. Inst. Metals*, 1933, **51**, 71–80.—E. S. H.

†On the Relation Between Structure and Properties Especially Between the Structure and Catalytic Activity of Solids [Lead–Thallium Alloys]. Erich Pietsch (*Metallwirtschaft*, 1933, **12**, 223–224).—A review of recent work with especial reference to the structure and catalytic activity of lead–thallium alloys. The activity reaches a well-marked minimum at 33% lead, indicating the existence of the compound $PbTl_2$.—A. R. P.

***Equilibrium in the Lead–Zinc System, with Special Reference to Liquid Solubility.** R. K. Waring, E. A. Anderson, R. D. Springer, and R. L. Wilcox (*Metals Technology*, **1934**, (Sept.), *A.I.M.M.E. Tech. Publ.* No. 570, 1–10).—The solubility of lead in zinc (*a*) and zinc in lead (*b*) at various temperatures is as follows: 417·8°, (*a*) 0·7, (*b*) 2%; 450°, (*a*) 1·4, (*b*) 2·3%; 500°, (*a*) 2·3, (*b*) 3%; 550°, (*a*) 4·0, (*b*) 4%; 600°, (*a*) 5·9, (*b*) 6%; 650°, (*a*) 9, (*b*) 8%; 700°, (*a*) 15, (*b*) 12%; 750°, (*a*) 24, (*b*) 19%; 775°, (*a*) 32, (*b*) 26%; 790° C. complete miscibility. The eutectic occurs at 0·5% zinc and 318·2° C., and the monotectic at 0·7% lead and 417·8° C.—A. R. P.

Lithium. —— Freitag (*Emaillewaren-Ind.*, 1934, **11**, 249–250; *C. Abs.*, 1934, **28**, 6408).—The properties and production of metallic lithium, and its effect in alloys are briefly discussed.—S. G.

†Electrical Conductivity and Equilibrium Diagram of Binary Alloys. XIV—The Lithium–Thallium System. G. Grube and G. Schaufler (*Z. Elektrochem.*, 1934, **40**, 593–600).—The lithium–thallium system has been investigated by thermal analysis and by the determination of the temperature–resistance curve of the solid alloys. The intermetallic compounds, LiTl, Li_2Tl_3, Li_5Tl_2, Li_3Tl, and Li_4Tl have been detected. In the range of composition of the last four of these compounds, the alloys are of a red to violet colour. The compounds LiTl, Li_5Tl_2, and Li_3Tl can be melted without decomposing, the melting points of Li_5Tl_2 (448° C.) and Li_3Tl (447° C.) being practically identical. The compounds Li_2Tl and Li_4Tl cannot be melted without decomposing, the upper limits of temperature for both these compounds being 381° C.
—J. H. W.

***Influence of Additions of Calcium and Beryllium on Oxidation of Magnesium Alloys.** V. V. Krylov (*Legkie Metalli* (*Light Metals*), **1933**, (7), 7–13).—[In Russian.] The influence of additions of 0·25–2% of calcium and 0·05–0·1% of beryllium on the oxidizability and mechanical properties of two magnesium alloys containing 4, 2, 0·2, and 8, 0, 0·2% of aluminium, copper, and manganese, respectively, has been studied. Calcium raises the hardness slightly and lowers the tensile strength by 3–4 kg./mm.^{2}, the elongation (with 2% Ca) by 85%, and the impact strength by 50% without affecting the elastic limit. Beryllium increases the hardness slightly and the tensile strength by 4%, but lowers the elastic limit by 8·8–7·8 kg./mm.^{2}. Both additions reduce the tendency to oxidize so that the alloys can be cast without spraying the mould with sulphur.
—D. N. S.

***Mechanism of Oxidation of the Alloys of Magnesium and of Calcium at High Temperatures.** Robert Delavault (*Compt. rend.*, 1934, **199**, 580–583).—As a result of further experiments, a qualitative explanation has been put forward for the phenomenon of the oxidation of magnesium and magnesium-rich alloys through the formation of protuberances with relatively large surfaces (cf. *Met. Abs.*, this volume, p. 383). The phenomenon was observed taking place very slowly in magnesium alloys containing 40% or more of aluminium. The magnesium could be protected during melting in air by small quantities of borofluoride. Pure magnesium, when the purity, and therefore the protection, is not sufficiently high, behaves like the alloys. Calcium reacts direct with air. If the melting point is lowered by the addition of, say, 10 mol.-% of silver, a reaction identical with that of pure magnesium results. The addition of other metals, such as copper, cadmium, zinc, and aluminium, gives analogous results. The explanation put forward is that the free surface of the magnesium or the magnesium-rich alloy is susceptible to oxidation and forms an adherent film. This film is not continuous; either its volume is insufficient, or the escaping metallic vapour tears it; but the edges of the film may act on the oxide molecules as they are formed, and these collect together, in limited numbers, perhaps to the extent of unit molecular thickness, instead of permitting the formation of numerous superimposed films. Two liquid phases of very different composition can, under different conditions, give rise to the same phenomenon. As a first approximation, the mechanism common to the various cases is either the formation of a superficial solution of magnesium on the metal, or the emission of gaseous magnesium, followed by oxidation and the modification of the liquid surface by the products of oxidation. (Cf. *Met. Abs.*, this volume, p. 412.)—J. H. W.

Elektron and Hydroaluminium. Otto Keinert (*Maschinenbau*, 1934, 13, 191–194).—Notes on the welding and working of these alloys and on their behaviour towards corrosive media.—K. S.

†**Electrical Conductivity and the Equilibrium Diagram of Binary Alloys. XIII.—Solid Solutions in the Magnesium–Tin System.** G. Grube and H. Vosskühler (*Z. Elektrochem.*, 1934, **40**, 566–570).—The solidus and phase boundaries of homogeneous magnesium-rich solid solutions has been investigated by electrical conductivity and dilatation measurements. The curves representing these hard properties are similar. There is a steep fall in both in the range of homogeneous solid solution and a minimum at the concentration of the compound Mg_2Sn.—J. H. W.

The Properties of Ultra-Light Magnesium Structural Alloys Compared with Other Engineering Metals (Magnesium Alloys Used in the Construction of Aircraft, Railroad Cars, Automobiles, and Trucks.) A. E. Drucker (*State Coll. Washington, Mines Information Bureau, Information Circ.* No. **5**, 1934, 14 pp.; *Metal. Res. Bureau, Information Circ.* No. **6**, 1934, 6 pp.; *C. Abs.*, 1934, **28**, 6682).—A compilation.—S. G.

A New Nickel–Chromium Alloy.—Inconel. Anon. (*Rev. Nickel*, 1934, **5**, 147–153).—The alloy contains approximately nickel 80, chromium 14, and iron 6%. Melting point, 1390° C.; modulus of elasticity 22,000 kg./mm.^{2}; tensile strength: annealed 56–66 kg./mm.^{2}, quenched 70–80 kg./mm.^{2}; elastic limit (annealed) 21–28 kg./mm.^{2}. It resists oxidation up to approximately 1100° C. and is less affected by sulphur than is pure nickel. Chemically it is similar to nickel but is superior in corrosion-resistance. Directions for heat-treatment are included.—W. A. C. N.

***Magnetic Material of High Permeability Attained by Heat-Treatment in a Magnetic Field [Permalloy].** R. M. Bozorth, J. F. Dillinger, and G. A. Kelsall (*Phys. Rev.*, 1934, [ii], **45**, 742).—Abstract of a paper read before the American Physical Society. Radical changes have been produced in the magnetic properties of some ferromagnetic materials by heat-treatment in a magnetic field. For example, the maximum permeability of Permalloy containing 65% nickel has been increased from 10,000 to 250,000 by heating to 700° C. and cooling slowly in a field of 15 oersteds. By so treating specimens which have been previously treated in hydrogen at 1400° C. the maximum permeability has been increased to 600,000. This material has a coercivity of 0·012 oersted, and a hysteresis loss of 50 ergs/cm.^{3}/cycle for a maximum induction of 10,000 gauss. The maximum permeability is the highest, and the coercivity and hysteresis loss for the condition given are the lowest, measurement of which has been reported for any strongly ferromagnetic material. High values of maximum permeability are generally attained by such heat-treatment in iron–cobalt–nickel alloys in the γ-phase, provided that the Curie point is higher than about 500° C. The hysteresis loops tend to have sharp corners and vertical sides; the authors have observed changes in induction of as much as 25,000 gauss when the field is increased by about 10^{-5} oersted. On such vertical sides, the time-lag in magnetization in specimens 0·15 mm. thick is as great as 1 minute.—S. G.

†**Alloys of Nickel and Copper Susceptible to Heat-Treatment.** W. T. Griffiths (*Rev. Nickel*, 1934, **5**, 119–122).—A summary of the properties and applications of copper–nickel–silicon and nickel–copper–aluminium alloys, and those with additions of tin, zinc, and manganese in addition to nickel, copper, and aluminium.—W. A. C. N.

***Effect of Prolonged Exposure to Steam at 450° C. on the Mechanical Properties of Various Steels and Alloys.** M. Sauvageot (*Chim. et Ind.*, **1934,** Special No. (April), 519–530; *Brit. Chem. Abs.*, **1934,** [B], 629).—Various steels, iron–nickel–chromium alloys, and Monel metal, of importance in boiler construction, have been examined. The hardness of certain steels increased after 1 year, but generally reached a maximum before the end of 3 years' exposure. Extra mild, nickel–chromium–molybdenum, and nickel–chromium austenitic steels, iron–nickel–chromium alloys, and Monel metal showed the least change in mechanical properties.—S. G.

†Peculiar Magnetic Behaviour of Cold-Rolled Iron–Nickel Alloys on Precipitation-Hardening (Development of Isoperm). O. Dahl and J. Pfaffenberger (*Metallwirtschaft*, 1934, 13, 527–530, 543–549, 559–563).—A critical review of the development of Isoperm alloys and of theories which have been advanced to account for their peculiar magnetic properties. In the light of our present knowledge it is concluded that the Isoperm effect is best accounted for by the assumption that precipitation of a constituent occurs during cold-rolling and produces internal stresses the nature of which determines the magnetic properties.—A. R. P.

†Nickel Alloys in Shipbuilding and Marine Engineering. Yasushi Taji (*Japan Nickel Rev.*, 1934, **2,** 248–307).—[In English and Japanese.] Deals with nickel–copper alloys containing less than 50% nickel and also with certain typical ternary alloys in which some copper is replaced by zinc, aluminium, or iron. Their physical properties and general application are discussed. Among the special alloys considered are: (1) those containing nickel 9–12, aluminium 1–3, zinc 0·5–3% which have high strength, elasticity, ductility, and toughness, maintained strength at higher temperatures, corrosion-resistance, and minimum elastic fatigue; (2) Iitaka metal, containing (approximately) copper 87·6, nickel 5·3, aluminium 7·1, and iron 0·34%; (3) N.M.–bronze, which is produced in three compositions. Materials appropriately in use for propeller blades, turbine blades, condenser tubes—in particular a number of proprietary brands of alloys—are summarized.—W. A. C. N.

†On Electrical Resistance Materials. Alfred Schulze (*Metallwirtschaft*, 1934, **13,** 369–372; and (abridged) *Z. Metallkunde*, 1934, **26,** 140).—The composition and physical properties of Manganin, nickel–brass, Nickelin, Constantan, Isabellin, chromium–nickel alloys, Megapyr, and Kanthal are tabulated, and curves are given showing the change in specific resistance of some of these alloys with increase in temperature. The use of these alloys as resistance elements is discussed with reference to recent work.—A. R. P.

***On the Alloys of Platinum and Chromium.** V. A. Nemilov (*Izvestia Platinogo Instituta* (*Ann. Inst. Platine*), 1933, (**11**), 125–134).—[In Russian.] The Brinell hardness ($P = 250$ kg.; $d = 10$ mm.), microstructure, and, in platinum-rich alloys, the electrical resistance and its temperature coeff., and the chemical resistance of chromium–platinum alloys have been determined. The hardness curve of annealed alloys is somewhat complicated; maxima occurring at 25 (300 Brinell), 45 (280), and 60 (280) atomic-% platinum and minima at 34 and 50 (150 Brinell) atomic-% platinum. The existence of the two compounds $PtCr_2$ and $PtCr$ is thus indicated. Quenching at temperatures higher than 1450° C. (almost at the melting point) gives a homogeneous solid solution. The electrical resistance has been measured for alloys up to 13·1 atomic-% chromium; with addition of chromium it rapidly increases, reaching at 13·1% chromium, 65 microhms/c.c. Sulphuric, hydrochloric, and nitric acids, both concentrated and dilute, even on boiling for $\frac{1}{2}$ hr. have no corrosive effect on the polished surface of the alloys containing up to 14 atomic-% chromium. Heating for 5 days at 1100° C. caused no change in weight in rolled strip of the 13·1 atomic-% chromium alloy, whereas a slight increase in weight occurred with strip of the 5·68 atomic-% chromium alloy.—N. A.

***Silver–Praseodymium Alloys.** G. Canneri (*Metallurgia italiana*, 1934, **26**, 794–796).—The system has been examined by thermal and micrographic methods. There are three compounds, $PrAg_3$ melting at 956° C., $PrAg_2$ formed by a peritectic action at 878° C., and PrAg melting at 928° C. Silver and $PrAg_3$ form a eutectic at 12·5% praseodymium and 774° C., $PrAg_2$ and PrAg form a second eutectic at 47·5% praseodymium and 802° C., and PrAg and praseodymium form a third eutectic at about 78% praseodymium and 582° C. Characteristic micro-structures are illustrated. Practically all the alloys are very hard and brittle.—A. R. P.

***Arsenic Poisoning of a Catalyst of the Tin–Barium–Vanadium Type, which was Poisoned Preliminarily by a Catalyst Poison.** I. E. Adadurov, P. P. Pershin, and G. V. Fedorovskii (*Zhurnal Prikladnoi Khimii* (*J. Applied Chem.*), 1933, **6**, 797–802; *C. Abs.*, 1934, **28**, 4182).—[In Russian.] The authors assumed that the poisoning of the catalyst with arsenic depends on the conversion of As_2O_3 to As_2O_5 on the catalyst, which takes place on other active centres than those of the oxidation of SO_2 to SO_3. Therefore, if the active centres which promote the conversion of As_2O_3 to As_2O_5 are poisoned, *i.e.* occupied by adsorbed molecules of another catalyst poison, then a further poisoning with arsenic cannot take place. A catalyst which has been poisoned to the limit with respect to its catalytic activity observed in poisoning with arsenic will not show any further lowering in its catalytic activity and it will not hold any arsenic. The tin–barium–vanadium catalyst was poisoned by illuminating gas to a slightly higher degree than with arsenic poisoning. It was justifiable to assume that all centres which assured the conversion of As_2O_3 to As_2O_5 were excluded from the catalytic activities. The catalyst, after having been poisoned preliminarily, was then poisoned with As_2O_3, the amount of arsenic on the basis of 17 c.c. of the catalyst amounting to 20·2 grm. As_2O_3 at a corresponding duration of the poisoning action of 156 hrs. In spite of such a great amount of As_2O_3, it was impossible to lower the catalytic ability of the substance any further, and the conversion curve after this additional poisoning did not show any difference from the conversion curve of the catalyst poisoned with illuminating gas. An investigation of the catalyst revealed that it held only 0·489 grm. or 2·2% arsenic calculated on the As_2O_3 passed. The small amount of As_2O_5 retained by the catalyst may be explained by oxidation by the oxygen of the gas. It is shown that the conversion curve of the unpoisoned catalyst, as well as that of the catalyst poisoned only by arsenic or only by another catalyst poison, and the curve of the catalyst which was preliminarily poisoned by another and then with the arsenic poison, all cross at 550° C., yielding about 91·5% of the theoretical conversion, indicating that the catalyst at the above temperature is working on quite different active centres and that its poisoning at the above temperature is actually not possible. The latter fact was confirmed experimentally.—S. G.

***A Microscopic Examination of Iron–Tin Reaction Products.** W. D. Jones and W. E. Hoare (*J. Iron Steel Inst.*, 1934, **129**, 273–280; discussion, 281).—See *Met. Abs.*, this volume, p. 345.—S. G.

***Ternary Alloys of Thallium and Lead with Cadmium and Tin.** N. S. Kurnakow and N. I. Korenew (*Izvestia Instituta Fiziko-Khimicheskogo Analisa* (*Ann. Inst. anal. phys.-chim.*), 1933, **6**, 47–68; *Chem. Zentr.*, 1934, **105**, II, 1084).—[In Russian.] From thermal analysis of these two ternary systems it is concluded that the dystectic point of the lead–thallium system corresponds with a solid solution of the isomorphous components, and that its composition changes with addition of cadmium or tin; this behaviour corresponds with the changes which occur in liquid–vapour systems, the characteristic points of which correspond to a minimum or maximum of the vapour pressure and change with the factors (temperature and pressure) which determine equilibrium. The electrical conductivity of lead–thallium alloys is only inappreciably affected by additions of 1% of cadmium or 5% of tin. The eutectic lines of both ternary systems deviate considerably from the straight lines joining the eutectics of the component binary systems.—A. R. P.

***The Viscous Properties of Extruded Eutectic Alloys of Lead–Tin and Bismuth–Tin.** C. E. Pearson (*J. Inst. Metals*, 1934, **54**, 111–124; discussion, 131–144).—The eutectic alloys showed deformation of a viscous character on being stressed continuously under a small load; this deformation was greatly in excess of the normal plastic flow under rapidly applied stress. The bismuth–tin eutectic showed this effect to an abnormal extent. The alloys were studied by testing in an apparatus devised by P. to give constant stress on the test-piece during an elongation of 150%. Typical results are given showing that the elongation at regular time intervals increased geometrically, satisfying the conditions of viscous flow. The viscosity possessed by the alloys is considered to be not that of simple liquids but resembles that shown by some disperse systems in which the viscosity coeff. is a function of the stress causing flow. Metallographic work indicated that the locus of viscous flow is to be found at the crystal boundaries and the behaviour of the alloys is thus influenced by the grain-size of the specimen. Measurements were made which related the decrease in the viscous property (on ageing or annealing) with an increase in grain-size.* X-ray examination showed no evidence of preferred orientation of the crystals in the extruded alloys.—R. G.

***A Note on Some Formulæ Concerning Viscous and Plastic Flow in Soft Metals.** E. W. Fell (*J. Inst. Metals*, 1934, **54**, 125–130; discussion, 131–144). —The flow of the metal in a prolonged ball-hardness test is compared with the flow in a tensile test-piece under constant stress (referring to Pearson's work; see preceding abstract). A formula used in connection with work by Hargreaves on continuous ball penetration of soft metals is discussed. Constants in this and formulæ for tensile tests are discussed with reference to the applicability of the tests and to the character of the flow of the metal. In reply to the joint discussion of this and Pearson's paper (preceding abstract), F. amplified his treatment of the formulæ with reference to the type of flow observed.—R. G.

Who Discovered Bearing Metals? Christopher H. Bierbaum (*Amer. Metal Market*, 1933, **40**, (180), 2, 5; and *Tin*, 1933, Dec., 21–23).—A short history of the evolution of bearing metal.—I. M.

Advances in the Field of Hard Metals. Karl Becker (*Metallwirtschaft*, 1934, **13**, 248, 342, 396, 565–566).—A review of recent patent literature on this subject.—A. R. P.

Fight for Quality in Hard Alloys. V. D. Romanow (*Redkie Metally* (*Rare Metals*), **1934**, (1), 19–23).—[In Russian.] Hard alloys of Russian manufacture are deficient in homogeneity of composition and in properties. More careful control of the manufacture and more homogeneous raw materials are required.—D. N. S.

***On the System Tungsten–Cobalt.** C. Agte, K. Becker, and Frhr. v. Göler (*Tech.-wiss. Abhandl. Osram-Konzern*, 1934, **3**, 127–128).—See *J. Inst. Metals*, 1933, **53**, 18.—v. G.

Replacement of Cobalt by Nickel in Pressed Hard Alloys. V. I. Tretiakov and N. D. Titov (*Redkie Metally* (*Rare Metals*), **1934**, (1), 24–26).—[In Russian.] The preparation of " Pobedit " with nickel instead of cobalt is described. A mixture of tungsten carbide and zinc dust is shaken with an ammoniacal solution of a nickel salt, and after precipitation of nickel is complete, the metallic residue is washed with water and alcohol and dried. Sintering is effected in the absence of carbon. The alloy containing 8% of nickel has a Rockwell-C hardness of 89. A cutting tool of such an alloy, when used for the turning of carbon steel (Brinell hardness 156) making a shaving of 3·4 mm.^{2} cross-section at a speed of 110 m./minute, was blunted after 3·5 minutes and at a speed of 90 m./minute after 13·25 minutes. The alloy is tough and does not crumble.—D. N. S.

***Cast Hard Alloys (Volomit, Perdurum, Volramit, Relit).** N. Zarubin and I. Raikhlin (*Redkie Metally* (*Rare Metals*), **1934**, (1), 34–42).—[In Russian.] From a microscopical study of cast hard alloys with a tungsten carbide basis their porosity is proved to be greater than that of sintered alloys (Widia, Carboloy, Pobedit), of alloys produced by hot-pressing and of alloys of the Stellite type. The outside of castings is more porous, and consists chiefly of tungsten carbide (WC) with excess of carbon, whereas the central portion appears to consist of the two carbides WC and W_2C. Alloys cast into octagonal or ovoid moulds contain more carbon than those cast into cylindrical moulds. As the volume of the casting is increased, so the carbon content diminishes. Owing to casting difficulties, the alloys are often non-homogeneous in composition and properties, but good castings have a Rockwell-C hardness of 90–95.—D. N. S.

***On the Melting-Point [of Alloys] in the System Tungsten–Rhenium.** K. Becker and K. Moers (*Tech.-wiss. Abhandl. Osram-Konzern*, 1934, **3**, 126).—See *J. Inst. Metals*, 1931, **47**, 142.—v. G.

***On the Solubility of Cadmium in Zinc at Room Temperature.** M. Straumanis (*Metallwirtschaft*, 1933, **12**, 175–176).—Electrochemical and microscopic evidence is given which indicates that the solubility of cadmium in zinc at room temperature is less than 0·1%. Higher values obtained by other investigators are attributed to the relatively rapid rate of cooling adopted and to the slow rate of diffusion of the metals in the solid state; equilibrium is attained only after very slow cooling.—A. R. P.

***The High Zinc Region of the Copper–Zinc Equilibrium Diagram.** E. A. Anderson, M. L. Fuller, R. L. Wilcox, and J. L. Rodda (*Metals Technology*, **1934**, (Sept.), *A.I.M.M.E. Tech. Publ.* No. 571, 1–29).—The system up to 3% copper has been examined in detail by X-ray, electrical conductivity, and micrographic methods. The solubility of copper in zinc rises linearly from 0·3% at 100° C. to 2·48% at 400° C. and 2·68% (extrapolated) at the peritectic temperature (424·5° C.). The intersection of the peritectic horizontal with the liquidus is at 1·9% copper. The divergence of these results from those of earlier workers is attributed to the difficulty in obtaining true equilibrium.—A. R. P.

***The Diffusion of Zinc and Iron at Temperatures Below the Melting-Point of Zinc.** Gilbert Rigg (*J. Inst. Metals*, 1934, **54**, 183–191; discussion, 191–192).—Experiments are described showing the course of diffusion when plates of zinc clamped between iron surfaces were heated at temperatures up to 380° C. Diffusion proceeded by formation of cones of diffusion products which penetrated into the zinc and the nature of which was governed largely by the nature of the iron surface. Two well-defined layers were formed; a thin layer of constant thickness (0·08 mm.) containing about 17% iron next to the iron surface and a thicker inner layer containing 0–11% iron. The principal diffusing constituent was the iron. The rate of penetration was independent of the grade of zinc. The mechanism of the diffusion process is discussed.—R. G.

***The Distribution of Thorium-*B* in Some Metals.** W. Seith and A. Keil (*Z. Metallkunde*, 1934, **26**, 68–69).—Tests on alloys produced by electrolysis of molten salts have shown that thorium-*B* is suitable only for measuring the diffusion of lead in lead and thallium and not in silver, bismuth, and cadmium, as the solubility of these metals, according to the data of Tammann and Bandel, is not yet definitely known. The proportion of thorium-*B* which remains in the middle of cadmium crystals depends on two factors, the solubility and the partition coeff. of thorium-*B* between metal and the intercrystalline cement. This coeff. should be particularly important if lead and bismuth (thorium-*B* and thorium-*C*) have a greater solubility in the intercrystalline cement than in the crystals of the ground-mass.—B. Bl.

***Methods of Preparation of Pure High-Melting Carbides, Nitrides, and Borides with a Description of Some of Their Properties.** C. Agte and K. Moers (*Tech.-wiss. Abhandl. Osram-Konzern*, 1934, 3, 130–133).—See *J. Inst. Metals*, 1933, **47**, 527.—v. G.

Special Alloys. Anon. (*Z. ges. Giesserei-Praxis: Das Metall*, 1934, **55**, 330, 352, 372).—The composition and some properties and applications of the following alloys are given: Ermann metal, Eutectic, Everbrite, Excelsior, Ex-B-Metal, Excello, F-Alloy, Track metal, and white gold. Cf. *Met. Abs.*, this volume, p. 495.—J. H. W.

Ageing in Metals. C. H. Desch (*Chem. and Ind.*, 1933, **52**, 402; also *Met. Ind.* (*Lond.*), 1933, **42**, 515; and *Found. Trade J.*, 1933, **48**, 370).—Abstract of a lecture given before the London Section of the Society of Chemical Industry.—J. H. W.

***Precipitation-Hardening and Secondary Structure.** K. H. Moore (*Phys. Rev.*, 1934, [ii], **45**, 296).—Abstract of a paper read before the American Physical Society. This is a preliminary report on the use of polarized light in the investigation of the possible connection between the phenomenon of precipitation-hardening and the secondary or mosaic structure of metallic crystals. The structure of an age-hardened alloy of copper and beryllium (2·5% Be) was studied by means of an improvised polarization microscope in an effort to connect the favoured planes upon which the first precipitation takes place with the hypothetical net of planes making up the secondary structure of crystals. Precipitation and coalescence of the precipitated particles were found to take place at the grain boundaries first, as expected. After a light etch to remove polishing flow, &c., the polarization microscope, with crossed nicols and in some cases a retarding plate, revealed nets of lines, indicating the surfaces traces of favoured planes, these being invisible under normal or conical non-polarized illumination. The question as to whether these are due to internal strain or actual presence of precipitate has not been definitely answered as yet. The usual period of etching with customary concentrations of reagent reveals a diffuse form of the same type of structure, because of preferential etching. With crossed nicols, the nets of lines observed after etching were resolved. The spacing of two rectangular nets, apparently a pattern of squares, was measured as slightly less than 10,000 A., indicating a possible connection between the planes favoured in precipitation and the secondary net of planes whose spacing has been estimated as being of that order of magnitude in metals. It may be significant that among a series of samples aged at various times at the optimum temperature the first reasonably complete and measurable nets were found in grains of the sample aged for the time found by other investigators to be the optimum time of treatment for producing hardness in this alloy.—S. G.

***Mechanism of the Grain-Refinement of Alloys by Peritectic Reaction.** Ju-n Asato (*Kinzoku no Kenkyu*, 1934, **11**, (7), 317–327).—[In Japanese.] Cf. *J. Inst. Metals*, 1933, **53**, 11, and *Met. Abs.*, this volume, p. 175. From microscopic study of peritectic alloys and from a theoretical consideration of the process of the peritectic reaction, it is concluded that during the reaction the dendritic primary crystals are disintegrated into many twists by the liquid which lies in their interstices, and as these twists behave as separate nuclei for each peritectic crystal, the grain-size of the latter becomes very fine.—AUTHOR.

†On the Influence of Chemical Composition and Grain-Size on Precipitation-Hardening. E. Söhnchen (*Metallwirtschaft*, 1934, **13**, 655–661; and (translation) *Light Metals Research*, 1934, **3**, 201–217).—Recent work on precipitation-hardening phenomena is critically reviewed with especial reference to the different behaviour of single-crystal and polycrystalline aggregates. In all cases the processes passes through three stages and can be accelerated or retarded by addition of other elements.—A. R. P.

Diffusion and Current Flow in Liquid Alloys. K. Schwarz (*Z. Elektrochem.*, 1933, **39**, 550–554; discussion, 554; *Brit. Chem. Abs.*, **1933**, [A], 908).—Abstract of a paper read before the Deutsche Bunsen Gesellschaft für angewandte physikalische Chemie. The transport numbers of sodium and potassium in their amalgams at 26° C. agree with the values calculated from the diffusion potentials. In such liquids the metal is practically completely dissociated into electrons and metallic ions of the lowest valency stage. In the electrolysis of binary liquid alloys, the ion with the greater charge density moves to the cathode.—I. M.

Developments in Heat- and Corrosion-Resistant Castings. Anon. (*Metal Progress*, 1934, **26**, (4), 51–56).—The rapid development of highly resistant alloys has brought with it a need for their systematic classification. That of Geiger applying to the iron–chromium–nickel alloys is quoted, together with diagrams correlating composition, structure, and applications. The influence of each ingredient on the properties of the alloy is reviewed. A discussion of the characteristics of suitable materials for furnace parts is followed by a summarized account of corrosion-resisting steels.—P. M. C. R.

†**Intermetallic Solid Solutions.** Eric R. Jette (*Metals Technology*, **1934**, (Aug.), *A.I.M.M.E. Tech. Publ.* No. 560, 1–16).—On the assumption that the chemical and physical requirements that must be fulfilled by solvent and solute atoms or molecules to enable solutions to obey Raoult's law are identical with those required for the additivity law of Vegard to hold for solid solutions, a study has been made of the results of numerous accurate determinations of lattice constants in intermetallic systems in which the solid solution range is large. The results show that, although some of these systems obey the additivity law, positive and negative deviations, often of considerable magnitude, frequently occur. Suggested causes of these deviations, based on the theory of co-ordination valency and superstructure formation, are discussed.
—A. R. P.

Progress in Processing Non-Ferrous Alloys. I.—Improvement by Heat-Treatment. II.—Use of New Alloying Constituents and Removal of Impurities. H. Kalpers (*Tech. Blätter deut. Bergwerkszeitung*, 1933, **23**, 467, 474–475).
—S. G.

***Physical Investigations Relating to New Magnetic Materials.** M. Kersten (*Z. tech. Physik*, 1934, **15**, 249–257).—The magnetic characteristics of new alloys called "Isoperm" (see also *Met. Abs.*, this volume, p. 571), characterized by abnormally small values of magnetic remanence, are examined. The abnormality is attributed to oriented heterogeneous precipitation.—J. S. G. T.

Interpretation of Paramagnetic Properties of Alloys. L. Néel (*Compt. rend.*, 1934, **198**, 1311–1313; *Sci. Abs.*, 1934, [A], **37**, 636).—By making certain assumptions about the preservation of the magnetic moments of atoms in solid solutions and about the distributions and mutual actions of the atoms, N. arrives at a certain formula for the atomic susceptibility of the alloys. This formula is interpreted and it is shown to agree, within the limits of experiment, with the results obtained by Bloch for the alloys of cobalt and nickel. The results obtained by this formula for other alloys are found to represent an extension and a confirmation of the ideas of Slater and Stoner.
—S. G.

Terminology Relating to Non-Metallic Elements in Metals. T. D. Yensen and C. H. Herty, Jr. (*Metals Technology*, **1934**, (June), *A.I.M.M.E. Tech. Publ.* No. 555, 1–13).—The general title "non-metallic elements in metals" is recommended as the name of the subject dealing with (*a*) non-metallic elements introduced unintentionally or for various definite purposes (*e.g.* oxygen, nitrogen, hydrogen, carbon, sulphur, phosphorus, &c.), and (*b*) phenomena occurring in metals caused by non-metallic elements, including those in the gaseous state. Under these headings a classification is proposed for the various states in which the non-metallic elements may occur in metals, and for the various reactions in which they may be involved. The proposed scheme has been submitted to leading metallurgists, and their comments, which are generally favourable, are included in the paper.—A. R. P.

***The Application of Nomograms to Metallographic Calculations.** W. P. Schischokin (*Metallurg* (*Metallurgist*), **1933**, (1), 20–34).—[In Russian.] Directions are given for the construction of nomograms for converting weight percentages into atomic percentages and *vice versa* in binary and ternary systems, and for calculating the electrical conductivity and resistance and the Brinell hardness of alloys.—N. A.

***Graphical-Analytical Method for Converting Weight, into Atomic, Percentage and Vice-Versa in Binary and Ternary Systems.** W. P. Schischokin (*Metallurg* (*Metallurgist*), **1934,** (4), 79–82).—[In Russian.] The method previously given can be simplified by replacing part of the graphical work by corresponding simple calculations. See *J. Inst. Metals*, 1933, **52,** 136, and preceding abstract. —N. A.

III.—STRUCTURE

(Metallography; Macrography; Crystal Structure.)

(Continued from pp. 495–498.)

***Observations on the Metallographic Etching of Platinum.** A. Jedele (*Metallwirtschaft*, 1934, **13,** 335–337).—On polishing platinum considerable surface flow occurs which renders etching difficult. The surface recrystallizes on heating and can then be satisfactorily etched. These facts explain the efficacy of Beck's etching process (see *Met. Abs.*, this volume, p. 77); there is no guarantee, however, that the structure revealed by this procedure corresponds with that of the central zone of the specimen.—v. G.

The Visibility of Slip Lines in Precious Metals. Otto Feussner (*Metallwirtschaft*, 1934, **13,** 627–628).—The somewhat opalescent blue lustre frequently seen on the surface of precious metals when illuminated in a certain direction is shown to be due to the presence of regularly oriented slip lines. Such lines appear in the crystals of vacuum-melted metals and in those of bent sheet (*e.g.* of palladium).. Two illustrations of characteristic slip structures are given and briefly discussed.—A. R. P.

***The Recrystallization of the Metallic Layers.** A. B. C. Anderson and A. Goetz (*Phys. Rev.*, 1934, [ii], **45,** 293).—Abstract of a paper read before the American Physical Society. Discussion of resistivity measurements of thin layers of silver deposited on amorphous and crystalline surfaces (calcite) by evaporation *in vacuo*. The change of conductivity after deposit under controlled conditions is used as a measure of recrystallization. It is found that the tendency of isolated atoms to form aggregates is independent of the number of atoms present and that the resistance per layer decreases suddenly when a definite statistical thickness is reached (300 atoms). This indicates the formation of crystalline groups of definite size, 10^{-5} to 10^{-4} cm. in diameter and are commensurable to the size of the primitive etch figure. The results are in agreement with certain findings of electron spectroscopy on the state of thin layers and support the hypothesis of the formation of large atomic groups in a crystal.—S. G.

Recrystallization Phenomena. A. E. van Arkel (*Polytech. Weekblad*, 1932, **26,** 397–400, 405–409, 421–424, 437–440).—A review.—S. G.

***The Rôle of Mechanical Twinning in the Recrystallization of Deformed Zinc Single Crystals.** V. D. Kuznetzov and V. A. Zolotov (*Dokladi Akademii Nauk S.S.S.R.* (*Compt. rend. Acad. sci. U.R.S.S.*), 1934, [N.S.], **2**, (1), 13–18).—[In Russian and German.]—N. A.

Replies to the Questionnaire on Dendrite, Monocrystalline State, Metal Grains, and the Mechanism of their Growth. —— (*Metallurg* (*Metallurgist*), **1932**, (7), 3–52; (8), 3–74).—[In Russian.] The Editor of the *Metallurg* sent the following questionnaire to scientists noted for their work in such fields: (1) How do you interpret the term "dendrite"? Is it a fusion of crystalline axes or a development of a single centre of crystallization? At what point does the dendrite throw out axes of the second, third, and higher orders? What does the D. K. Tchernov crystal consist of? Is it a single dendrite or a fusion of several crystals? (2) How do you interpret the term "monocrystalline state"? Is an ingot monocrystalline when it is (*a*) composed of dendrites identically orientated, (*b*) composed of several grains identically orientated? Does the presence of twinning prevent a grain or ingot from being monocrystalline? (3) How do you formulate the conception of a metallic grain in a solid solution and eutectic mixture? Is the rate of crystallization of crystalline units from molten metal a value characteristic of each individual metal and alloy or is it determined by the physical conditions of crystallization? Is the rate of formation of nuclei a definite quantity characteristic of the liquid and solid states of the metals? What is the mechanism of the formation of crystal grains inside an ingot? (4) What is the mechanism of grain-growth in the solid state? Replies were received from W. Rosenhain, S. S. Steinberg, G. Tammann, M. G. Oknov, C. Benedicks, N. T. Gudtzovy, A. Stansfield, P. Goerens, G. A. Kaschtchenko, F. C. Thompson, I. S. Gaev, T. A. Lebedev, A. A. Baikov, J. N. Greenwood, M. P. Slavinsky, K. Honda, T. Sutoki, F. Sauerwald, F. von Göler, A. A. Botchvar, I. E. Gorshkov, M. F. von Schwarz, O. Summa, P. A. Chevenard, A. M. Portevin, and D. S. Beliankin. All these are published.—N. A.

***On the Work of L. Northcott on Veining Structures.** I. E. Gorshkov (*Metallurg* (*Metallurgist*), **1933**, (6), 56–59).—[In Russian.] Cases of the formation of veining structures, not mentioned by L. Northcott (*J. Inst. Metals*, 1932, **50**, 614; 1933, **53**, 239), are described. Types of veining structure are classified.—N. A.

Limiting Domains of Metallography. K. Schröter (*Tech.-wiss. Abhandl. Osram-Konzern*, 1934, **3**, 133–137).—See *J. Inst. Metals*, 1932, **50**, 32.—v. G.

***Structure and Growth of Thin Surface Films on Metals by Oxidation in the Air.** A. Steinheil (*Ann. Physik*, 1934, [v], **19**, 465–483; and (translation) *Light Metals Research*, 1934, **3**, 1–11).—Surface films on aluminium and tin have been investigated with electron rays; those on aluminium have a cubic face-centred lattice, $a = 5{\cdot}35$ A. Films produced at higher temperatures have a similar lattice with $a = 7{\cdot}77$ A., corresponding with γ-alumina, but they always contain crystals of the β-modification. Films on tin consist partly of stannic and partly of stannous oxide. Oxide films on aluminium grow rapidly at first, a thickness of 3×10^{-5} mm. being reached in 2 days, but about a month is required to reach a thickness of 4×10^{-5} mm.—v. G.

***X-Ray Determination of the $FeAl_3$ Structure.** E. Bachmetew (*Z. Krist.*, 1934, **88**, [A], 179–181; *Chem. Zentr.*, 1934, **105**, II, 1264).—From Laue, Debye–Scherrer, and rotating crystal röntgenograms of $FeAl_3$ it is concluded that this compound is of rhombic symmetry V_h with $a = 15{\cdot}485$ A. $\pm$ 0·25%, $b = 8{\cdot}111$ A. $\pm$ 0·12%, and c probably 47 A. The translation group is thus face-centred on all sides.—A. R. P.

Röntgenography of Duralumin. B. A. Krasiuk and S. S. Bogomolov (*Zavod. Lab.*, 1934, **3**, 336–339; *Brit. Chem. Abs.*, **1934**, [B], 678).—[In

Russian.] The use of X-rays in investigating the macrostructure is illustrated.—S. G.

***The Photoelectric Properties of the (100) and (111) Faces of a Single Copper Crystal.** Newton Underwood (*Phys. Rev.*, 1934, [ii], **45**, 745).—Abstract of a paper read before the American Physical Society. The two faces were cut from the same single crystal, and etched to remove the broken surface pieces and to expose the true crystal structure. Care was taken to prevent any contacts between the prepared planes and foreign objects. The two specimens were heated simultaneously by electronic bombardment at various red-heat temperatures for over 1500 hrs. in a good vacuum. The photoelectric thresholds were measured by the use of filters as the degassing proceeded. During readings, the pressure was less than 5×10^{-8} mm. mercury. After 500 hrs. of degassing the threshold wave-lengths were 2536 A. for the (111) face and between 2200 A. and 2300 A. for the (100) face. The uncertainty is due to the ambiguity in interpreting the data. The results show that the etching produced by evaporation should be avoided in such an experiment. The work is being continued with a monochromatic illuminator to obtain more precise values.—S. G.

***Crystal Structure and Ferromagnetism of Manganese–Aluminium–Copper Alloys.** Otto Heusler (*Ann. Physik,* 1934, [v], **19**, 155–201).—Quenched copper–aluminium–magnesium alloys have a cubic lattice, the parameter of which shows a well-marked maximum for all alloys with 25% aluminium; the lattice is of the sodium chloride type with manganese and aluminium atoms at the lattice points and a copper atom in the middle of the cube. The arrangement of the atoms at the lattice points is not perfect in the quenched alloy but is improved by low-temperature (100° C.) ageing. The electrical resistance for all alloys with 25% aluminium shows a well-defined minimum, with a maximum temperature coeff.; after ageing at 110° C. the resistance decreases and the temperature coeff. increases. The change in magnetic properties with temperature, time of ageing, and composition has been investigated; here also alloys with 25% aluminium are peculiar. Magnetization is increased by ageing.—v. G.

***Parameters of Copper–Nickel Alloys.** E. A. Owen and L. Pickup (*Z. Krist.*, 1934, **88**, [A], 116–121; *Chem. Zentr.*, 1934, **105**, II, 1083).—The parameters of various copper–nickel alloys have been determined to ± 0·0003 A. with a precision camera. The results show that a lattice contraction occurs on alloying which reaches a maximum of 0·11% at 34 atomic-% nickel. The calculated density reaches a maximum of 8·949 (18° C.), the values for pure copper and nickel being 8·938 and 8·895 respectively.—A. R. P.

***The Crystal Structure of a Complex Copper–Silicon Compound.** F. Rolf Morral and A. Westgren (*Arkiv Kemi Mineral. Geol.*, 1934, [B], **11**, (37), 1–6; *Chem. Zentr.*, 1934, **105**, II, 1264).—The homogeneous phase with a body-centred cubic lattice ($a = 9{\cdot}694$ A.) which occurs in copper–silicon alloys below 600° within a narrow range of composition appears to be the compound $Cu_{15}Si_4$ having 76 atoms in the unit cell. The disposition of the atoms in the cell has been determined; every silicon atom is surrounded by 9 copper atoms, three being at a distance of 2·62, three at 2·59, and three at 2·51 A. from the central silicon atom.—A. R. P.

***The Crystal Structure of $AuAl_2$.** C. D. West and A. W. Peterson (*Z. Krist.*, 1934, [A], **88**, 93–94; *Chem. Zentr.*, 1934, **105**, II, 1264).—$AuAl_2$ has a face-centred cubic lattice with $a = 6{\cdot}00 \pm 0{\cdot}02$ A. and 4 molecules in the unit cell, $d_{calc.} = 7{\cdot}66$. The structure is apparently of the calcium fluoride type; the distance between the gold and aluminium atoms is 2·58 A., *i.e.* appreciably less than the sum of the atomic radii (2·87 A.).—A. R. P.

***The Crystal Structure of the Compounds $LaMg_3$, $CeMg_3$, and $PrMg_3$.** A. Rossi and A. Iandelli (*Atti R. Accad. Lincei* (*Roma*), 1934, [vi], **19**, 415–420;

Chem. Zentr., 1934, **105**, II, 1264–1265).—Homogeneous compounds of this composition were obtained by repeated melting of a mixture of the components in correct proportions, and they were then examined by the powder method. All the compounds are cubic and contain four molecules in the unit cell. The lattice parameters are $LaMg_3$ 7·478 A., $CeMg_3$ and $PrMg_3$ 7·373 A.—A. R. P.

***On the Alloys of Lithium and Cadmium.** A. Baroni (*Atti R. Accad. Lincei* (*Roma*), 1934, [vi], **19**, 507–509; *Chem. Zentr.*, 1934, **105**, II, 1890).—Cf. *Met. Abs.*, this volume, p. 77. The compound LiCd is dimorphous, the monoclinic form becoming cubic after heating for 30 hrs. at 300° C. The compound Li_3Cd decomposes with very slow cooling and can be reformed only by prolonged heating at 350° C.—A. R. P.

***X-Ray Investigation of Red Monoclinic Selenium. Evidence for the Occurrence of Two Red Monoclinic Forms of Selenium.** Harold P. Klug (*Z. Krist.*, 1934, [A], **88**, 128–135; *Chem. Zentr.*, 1934, **105**, II, 1093).—X-Ray examination of the two forms of selenium prepared by Muthmann's method have confirmed their existence. The α-form contains 32 atoms in the unit cell which has $a' = 8{\cdot}992$, $b' = 8{\cdot}973$, $c' = 11{\cdot}52$ A., and $\beta' = 91° 34'$; the β-form has also 32 atoms in the unit cell but the lattice constants are $a = 12{\cdot}74$, $b = 8{\cdot}04$, $c = 9{\cdot}25$ A., and $\beta = 93° 4'$. The α-form has a very similar lattice to that of rhombic sulphur.—A. R. P.

On the Paper: "Crystal Structure and Lattice Constants of α-(β-) Tungsten." By M. C. Neuburger. Fritz Ebert and Hellmuth Hartmann (*Z. Krist.*, 1934, **87**, 183; *Brit. Chem. Abs.*, **1934**, [A], 243).—N.'s work (*Met. Abs.*, this volume, p. 13) is criticized, and the proposed interchange of the names α- and β-tungsten is deprecated.—S. G.

***Measurement of a Hexagonal Crystal Lattice: Zinc.** J. Weigle (*Helv. Phys. Acta*, 1933, **7**, 51–56; *C. Abs.*, 1934, **28**, 2965).—The parameter of the base of zinc is 2·6585 A.—S. G.

***The Process of Transition of the Cubic Body-Centred Modification into the Hexagonal Close-Packed Modification of Zirconium.** W. G. Burgers (*Physica*, 1934, **1**, 561–586; *C. Abs.*, 1934, **28**, 6042).—A detailed crystallographic and X-ray study was made of the lattice transformation of cubic zirconium into hexagonal zirconium. The latter crystals lie with their 0001 plane parallel to 110 of the cubic crystal, a $11\bar{2}0$ axis being parallel to a 111 direction. The orientation is brought about by applying to the cubic crystal a shear parallel to the 112 plane in a 111 direction, followed by displacement of alternate atom layers and a homogeneous contraction. Several alternate possibilities are discussed, including one with an intermediate face-centred state. The relation between these changes and the physical properties of zirconium is likewise discussed.—S. G.

***Crystallite Orientation in a Polycrystalline Metal During Plastic Flow.** R. E. Gibbs and N. Ramlal (*Phil. Mag.*, 1934, [vii], **18**, 949–956).—In confirmation of results obtained by Andrade and Chalmers, X-ray measurements show that when a polycrystalline metal flows, the part of the flow which gradually diminishes with time is associated with rotation of the axes of the crystallites.—J. S. G. T.

Relation Between Amorphous and Crystalline Scattering and Its Application to Crystal Analysis. N. S. Gingrich and B. E. Warren (*Phys. Rev.*, 1934, [ii], **45**, 762–763).—Abstract of a paper read before the American Physical Society. The expression for the intensity of X-ray scattering from an amorphous substance must also be applicable to a crystal. From this consideration, an expression is obtained for the average radial distribution of atoms about any one atom, expressed as a series over the number of lines in the powder pattern. The coeff. in the series are given directly by the integrated *intensities* of the different powder pattern lines. As the coeff. are determined by intensities and not amplitudes, there is no ambiguity due to phase, and an average radial distribution function is obtained directly from the powder pattern. For a crystal containing only one kind of element the series takes a particularly simple form

$$p(r) = \sum_{hkl} Khkl \frac{\sin sr}{sr} - \frac{e^{-r^2/4B}}{8\pi^{3/2}B^{3/2}}; \quad s = \frac{4\pi \sin \theta}{\lambda}$$

Khkl is given by the integrated intensities of the lines, and *B* is proportional to the Debye temperature factor. The second term can be neglected except at very small values of *r*. The series has been applied to several crystals with known structures. By this method direct inter-atomic distances are obtained without necessarily determining a complete structure.—S. G.

†**Structural Crystallography.** J. D. Bernal and D. M. Crowfoot (*Ann. Rep. Prog. Chem.*, 1933, **30**, 379–430).—Includes a comprehensive survey of recent work on metals and alloys.—E. S. H.

***Segregation of Polonium in Bismuth Crystals [Evidence for Secondary Structure in Metallic Crystals].** Alfred B. Focke (*Phys. Rev.*, 1934, [ii], **46**, (7), 622–628).—Single crystals of bismuth containing very small quantities of polonium were prepared, and the number–distance relations for α particles emitted normally to the (111) and $(11\bar{1})$ planes were studied. The curves obtained showed fairly regular steps indicating that the polonium is segregated into small regions with nearly regular spacings, which are ($0{\cdot}54 \pm 0{\cdot}03\ \mu$) for planes parallel to the (111) plane, and ($0{\cdot}90 \pm 0{\cdot}1\ \mu$) for planes parallel to the $(11\bar{1})$ plane. These distances are not affected by the rate of crystallization from the liquid metal, or by subsequent heat-treatment. The addition of tellurium as well as polonium suppresses alternate layers parallel to the (111) plane, and removes all evidence of layers parallel to the $(11\bar{1})$ plane. F. regards the experiments as supplying the first direct evidence for the secondary structure predicted by Zwicky.—W. H.-R.

***On the Coefficient of Transformation of a Crystalline Body and on the Molecular Structure of Crystals.** P. N. Pavlov (*Zhurnal Fizicheskoy Khimii* (*J. Phys. Chem.*), 1933, **4**, (6), 883–996).—[In Russian.]—N. A.

†**On the Physics of Crystals.—I.** F. Zwicky (*Rev. Modern Physics*, 1934, **6**, 193–208).—Z. gives a most valuable review of the theory of ideal lattices and its application to the elastic properties of crystals. The dependence of the elastic constants on pressure, temperature, cross-section, and imperfections is described, with examples of both metallic and non-metallic crystals. The limitations of the ideal theory are indicated, and arguments advanced that the lack of agreement cannot be ascribed solely to imperfections.—W. H.-R.

On the Problem of the Solid State. F. Zwicky (*Phys. Rev.*, 1932, [ii], **41**, 400–401).—Abstract of a paper read before the American Physical Society at a symposium on plasticity.—S. G.

X-Rays in Metallography. J. Díaz Orozco (*Chemia*, **1931**, (39/40), 582–593; (41/42), 645–657).—A review.—S. G.

IV.—CORROSION

(Continued from pp. 498–502.)

Peculiar Destruction of a Steel–Aluminium Cable. H. Röhrig and K. Schönherr (*Elektrotech. Zeit.*, 1934, **55**, 813–814).—A 15 kw. steel–aluminium conductor erected in Germany in 1915–1916 showed, besides severe rusting of the steel core, severe corrosion of the inner parts of the aluminium strands. The cause of the trouble is considered to be insufficient impregnation of the jute insulation.—B. Bl.

Corrosion Tests on Pure Aluminium and Its Alloys. A. von Zeerleder and E. Zurbrügg (*Congrès. internat. mines, mét., géol. appl., Sect. de Mét., Liège*, **1930**, 599–610).—See *J. Inst. Metals*, 1933, **53**, 131.—S. G.

***Corrosion Tests on Hydronalium.** P. Brenner (*Z. Metallkunde*, 1933, **25**, 252–254; discussion, 255–258).—The average tensile strength of Hydronalium is 32–36 kg./mm.^{2}, with a yield-point of 15–20 kg./mm.^{2} and an elongation of 20–15%. In 3% sodium chloride solution kept in agitation no change in tensile strength occurs after 100 days; the elongation of the hard-worked alloy also remains constant, but that of the annealed alloy decreases slightly during the early stages of exposure to the solution. Under similar conditions Duralumin 681A loses 20% of its tensile strength and 60% of its ductility, and pure aluminium about 10% of its tensile strength; the whole surface of the Duralumin is coated with corrosion products after the test, and that of aluminium contains numerous isolated pits, whereas that of Hydronalium is perfectly free from blemishes. Hydronalium is practically inert to sea-water, even at the air–water line. In the discussion *Sterner-Rainer* pointed out that Hydronalium alloys were essentially the same as Magnalium which has been known for many years; their resistance to corrosion is produced by a homogenizing heat-treatment, the heterogeneous cast alloys and those in which a second constituent has been precipitated by tempering being quite readily susceptible to salt-water attack. *Schmidt* stated that the resistance of Hydronalium alloys to attack by 5% sodium hydroxide solution increased quite suddenly at 8–10% magnesium; in the quenched homogeneous state the alloys were too soft for constructional purposes, but could be heat-treated to precipitate about 1–2% of the magnesium content without affecting the corrosion-resistance while at the same time improving the strength and hardness. Other speakers discussed the welding of the alloys and its effect on the corrosion-resistance, the resistance of alloys with less magnesium and more manganese, *e.g.* Birmabright, to corrosion, and the effect of precipitation-hardening on the corrosion-resistance.—A. R. P.

***The Electrode Potentials of the Structural Constituents of Aluminium Alloys.** Georg W. Akimow and Alexander S. Oleschko (*Korrosion u. Metallschutz*, 1934, **10**, 133–135).—The potentials of various constituents of aluminium alloys against the *N*-hydrogen electrode in 3% sodium chloride solution at 17°–18° C. are as follows: aluminium − 0·55, silicon − 0·421 to − 0·508, $FeAl_3$ − 0·14 (10 minutes), − 0·333 (5 hrs.) to − 0·200 (25 hrs.' immersion), $CuAl_2$ − 0·26 to − 0·607, Mg_2Si − 1·275 to − 0·427, $NiAl_3$ − 0·49 to − 0·471 v. —A. R. P.

***Contribution to the Solubility of Copper in Water with Respect to the Application of the Metal in the Construction of Water Pipes.** Victor Froboese (*Gas- u. Wasserfach*, 1934, 77, 225–231).—The presence of copper in water can be detected by taste when the amount exceeds 1·5 mg./litre. The solubility of copper in water is determined by the carbon dioxide content; the presence of normal amounts (7–8 mg./litre) of oxygen in water is sufficient, when sufficient carbon dioxide is also present, to cause relatively large amounts of copper to be dissolved. Drinking-water fed to copper pipes should therefore be thoroughly deoxygenized. From the solubility of cuprous and cupric oxides in water it is concluded that only cupric compounds will provide a suitable protective film on copper pipes; films produced in hard waters consist of copper–calcium carbonates. Sodium chloride and magnesium sulphate do not increase the solubility of copper in water.—B. Bl.

***The Behaviour of Copper, Nickel, and Copper–Nickel Alloys Towards Attack by Washing and Bleaching Agents.** O. Bauer and H. Arndt (*Metallwirtschaft*, 1934, 13, 241–245).—At 75° C. copper is seriously attacked by solutions of soap and soda, but the attack by soda is appreciably reduced by addition of sodium perborate; commercial detergents free from soap and chlorine have very little action on copper. Nickel and copper–nickel alloys are highly resistant to soaps, alkali carbonates, and perborates, the rate of corrosion of the alloys increasing with the copper content. Bleaching materials containing hypochlorites and free chlorine are highly corrosive towards copper, nickel, and copper–nickel alloys, and should not therefore be handled in vessels of these materials.—A. R. P.

On a Peculiar Oxidation Phenomenon in a Church Bell. Wilhelm Witter (*Metallwirtschaft*, 1933, 12, 21–22).—A bronze bell in St. Paul's Church, Halle, showed after 30 years peculiar, shallow, bowl-like depressions filled with corrosion product consisting of tin 3·80, copper 31·20, lead 0·12, antimony 0·43, zinc 0·94, nickel 0·05, arsenic 0·11, chlorine 0·35, sulphur 8·24, iron 2·41, silica 8·00%, the metals being present as basic carbonates and sulphates. The bronze contained tin 16·75, copper 76·50, lead 2·46, antimony 0·72, zinc 0·89, nickel 0·05, iron 2·17, sulphur 0·42, arsenic 0·12%. Corrosion is attributed to the high sulphur dioxide content of the atmosphere of Halle, and to the high sulphur and iron contents of the bronze; the silica content of the corrosion product is ascribed to wind-borne dust.—A. R. P.

Corrosion of the [Brass] Caps of Electric Lamps. Otto Herbatschek (*Korrosion u. Metallschutz*, 1933, 9, 209–212).—Examples of corrosion of 63 : 37 brass caps carrying the lead-in wires of electric lamps are discussed; they show considerable pitting, exfoliation, and dezincification phenomena. These are attributed to the action of moisture, carbon dioxide, and sulphur dioxide in the air combined with the heat developed by the burning of the lamp, and possibly accelerated by stray currents.—A. R. P.

Report of the Dutch Corrosion Commission III on the Study of the Attack on [Lead] Cables under the Influence of the Soil. Anon. (*Korrosion u. Metallschutz*, 1933, 9, 205–208).—Laboratory tests with various protective materials impregnated with tars and waxes showed that the presence of tar acids accelerates corrosion of lead considerably, especially when there is free access of air; phenol is corrosive in the absence of air, basic lead carbonate being the chief corrosion product obtained. Examination of numerous cases of corroded lead cable sheathing has confirmed the conclusion that the use of tar as impregnating material for the jute insulation is the primary cause of corrosion. Good protection of underground lead cables is afforded only by impregnating materials which are completely waterproof and, at the same time, good insulators.—A. R. P.

Corrosion of Lead–Antimony Alloy. F. K. Fischer (*Sci. Mem. Univ. Saratov*, 1934, **10**, 91–105; *Brit. Chem. Abs.*, **1934**, [B], 631).—Differences in the degree of corrosion of lead–antimony electrodes during electrolysis of aqueous sodium acetate, formate, chloride, and nitrate are due chiefly to alkalization of the perianodal fluid during electrolysis. Corrosion of accumulator plates when the electrolyte contains more than 0·1% sodium chloride is ascribed to the same cause.—S. G.

Corroding Effects of Asbestos on Nickel and Its Alloys.—I. E. Schürmann and W. Esch (*Kautschuk*, 1934, **10**, 101–104, 119–121; *Brit. Chem. Abs.*, **1934**, [B], 840).—One of the most important factors leading to corrosion by asbestos is the presence of minute crystals of iron disulphide which under the influence of moist air and the catalytic action of the naturally occurring water-soluble salts leads to the conversion of nickel into nickel sulphate. Careful washing with distilled water reduces but does not eliminate entirely the danger of such corrosion. As iron may be present also, in the form of harmless oxides, the total iron content of the asbestos is of no use as an indication of its degree of suitability, and microscopical and chemical examination should be directed to ensure complete freedom from iron disulphide.—S. G.

On the Anodic Behaviour of the Iron Group Metals [Nickel]. W. J. Müller (*Korrosion u. Metallschutz*, 1934, **10**, 1–5).—Iron, cobalt, and nickel all become coated with a thin film of oxide or hydroxide on exposure to the air; this film is least stable with iron and most stable with nickel. In nickel suplhate solutions of p_H 5 and even in N-sulphuric acid only partial removal of this film from nickel takes place on anodic polarization, but in $15N$-sulphuric the film slowly disappears entirely. The behaviour of nickel anodes is shown to be completely in accord with M.'s theory of coating passivity.—A. R. P.

***Conditions of Resistance to Attack by Hydrochloric Acid of Iron-Nickel-Tungsten or -Molybdenum Alloys.** A. Portevin, E. Prétet, and H. Jolivet (*Chim. et Ind.*, **1934**, Special No. (April), 464–471; *Brit. Chem. Abs.*, **1934**, [B], 628).—A study has been made of the alloys of iron–nickel–tungsten and iron–nickel–molybdenum containing nickel 20–40 and tungsten or molybdenum 10–25%. They show a considerable resistance compared with the unoxidizable alloys ordinarily used. The corrosion diminishes with increase in tungsten and increases rapidly with increase of temperature, being less, however, the greater the nickel content. It is increased considerably by the presence of certain impurities such as carbon.—S. G.

***The Electrochemical Behaviour of the Tin-Iron Couple in Dilute Acid Media.** T. P. Hoar (*Trans. Faraday Soc.*, 1934, **30**, 472–482).—Experiments in dilute acids are described which prove that the reversal of the e.m.f. of the tin–iron couple after a relatively short period of immersion is due to the dissolution of the oxide films on the surface; owing to the removal of stannous ions as complexes tin is anodic to iron in citrate and oxalate solution, but in sulphuric acid solutions where no complex is formed it behaves as the cathode. Both metals are corroded by citric acid solutions and by citrate solutions buffered to p_H 5 when they are not in contact with one another, but the rate of corrosion of tin is increased and that of iron decreased when the two metals are in electrical contact owing to the superimposed effect of the couple current; hence tinplate corrodes less rapidly than uncoated iron in this type of solution unless the amount of dissolved tin is excessive. The rate of corrosion is increased by free access of air but is not affected by the acidity of the electrolyte. H. concludes that research on the minimizing of tinplate corrosion should be directed to the discovery of inhibitors of the cathode reaction at the iron surface, *e.g.* by additions or alterations to the steel used in the manufacture of the tinplate or by suitable additions to the corrosive medium.—A. R. P.

***The Corrosion of Zinc in Chloride Solutions.** C. W. Borgmann and U. R. Evans (*Trans. Electrochem. Soc.*, 1934, **65**, 249–270; discussion, 270–274).—For abstract of the paper, see *Met. Abs.*, this volume, p. 131. In the discussion *F. N. Speller* stated that 1% of copper in zinc increased the resistance to corrosion in fresh-water by 15%. *G. D. Bengough* and *F. Wormwell* said that the rate of corrosion of cast zinc fell with increase in chloride concentration of the solution even when the rate of oxygen supply was considerably increased; they rejected the theory that circulation caused by the descent of corrosion products replenished the oxygen supply over a plane vertical surface, but the authors provided further evidence in support of this theory. *F. C. Frary* pointed out the importance of even minute amounts of impurities in determining the nature and rate of corrosion of zinc; the state of distribution of the impurities might produce the considerable differences observed in the corrosion of cast and wrought zinc. *William Blum* stated that atmospheric exposure tests at Key West, Florida, had shown that electroplated zinc coatings on steel were just as protective as hot-dipped coatings.—A. R. P.

†**The Zinc Coating of Water Pipes and Water Containers.** Erich Naumann (*Gas-u. Wasserfach*, 1934, **77**, 528–534).—Numerous practical experiences with galvanized objects in waterworks are detailed. A discussion follows.—B. Bl.

***Chemical Resistance of Metallic Solid Solutions.** V. V. Skortcheletti and B. M. Idelchik (*Metallurg* (*Metallurgist*), **1934**, (2), 30–43; (3), 27–38).—[In Russian.] The corrosion-resistance of magnesium–cadmium and nickel–copper alloys has been studied from the point of view of Tammann's theory of resistance limits. After immersion for 4 hrs. in 0·1N-sulphuric acid at 10° C., magnesium–cadmium alloys show a well-marked limit at 25 atomic-% cadmium (2/8) and a less marked limit at 12·5 atomic-% cadmium (1/8). Rotation of the specimen does not affect the result. At 25° C. the upper limit disappears, probably owing to diffusion in the solid solution. Prolonged action of chemically active reagents on the alloy, in which diffusion occurs, displaces the resistance limit towards increased concentration of the more noble metal. These limits also occur in solutions of sodium and ammonium chlorides. These results are reviewed on Tammann's theory and attention is directed to the influence of relation between the atomic dimensions in the alloy and the ionic dimensions in the corrosive reagent, which is considered to be the SO_4 group when sulphuric acid is used. Measurement of the dissolution potentials of magnesium–cadmium alloys indicates that this method used independently does not always afford a correct idea of the chemical stability of alloys. Nickel–copper alloys in ammonia show clearly-defined resistance limits at 1/8, 2/8, and 4/8 mol. In contact with anhydrous sulphur chloride these alloys show no resistance limits.—N. A.

***Studies on the Corrosion of Dairy Utensils in Sour Skim Milk, Semi-Solid Sour Milk, Sour Whey, and Thickened Sour Whey.** W. Mohr, R. Kramer, and W. Schröter (*Molkerei-Zeit.* (*Hildesheim*), 1934, **48**, 1054–1056; *C. Abs.*, 1934, **28**, 6863).—The corrosive action of several milk products of varying acidities on numerous metals and alloys was tested. Results were indicated by loss in weight and by the appearance of corroded surfaces. The materials tested were: (1) iron; (2) V2A steel; (3) V2A welded steel; (4) tinned iron; (5) half-tinned iron; (6) nickel; (7) nickel–brass; (8) unwrought copper; (9) polished copper; (10) bronze; (11) red brass; (12) brass; (13) soldered copper; (14) tinned copper; (15) spray-tinned copper; (16) half-tinned copper; (17) tinned and soldered copper; (18) lead; (19) zinc; (20) 99·5% aluminium; (21) 99% aluminium; (22) refined Duralumin; (23) Anticorodal B, and (24) enamelled steel. The dairy products studied, with the titratable acidities in degrees, respectively, Soxhlet–Henkel (S.–H.), temperature and times of contact with the metals were: (*a*) skim milk, 38°–40° S.–H., 19°–20° C., 48 hrs.; (*b*) soured skim milk 38°–40° S.–H., 19°–20° C., 48 hrs.; (*c*) strongly soured skim milk, 72°–90° S.–H., 40°–42° C., 24 hrs.; (*d*) strongly soured skim milk, 80°–90° S.–H., 60° and 75° C., stirred 3 hrs.; (*e*) semi-solid sour buttermilk and a special sour protein product, 260° S.–H., 60° and 75° C., stirred 3 hrs.; (*f*) semi-solid buttermilk and sour protein, 260° S.–H., 19°–20° C., 48 hrs.; (*g*) sour rennet whey, 60° S.–H., 60° and 75° C., stirred 3 hrs.; (*h*) thickened sour whey without added chalk, 330° S.–H., and with chalk, 140° S.–H., 60° and 75° C., stirred 3 hrs., and (*i*) thickened sour whey without chalk, 330° S.–H., and with chalk, 140° S.–H., 19°–20° C., 24 hrs. Materials (2) and (3) were fully resistant to all products; (19) and (1) were least resistant. Products (*a*) and (*b*) were least corrosive; (*h*) and (*e*) were most corrosive. Materials (3) to (17), inclusive, were fairly resistant to products (*a*), (*b*), (*c*), (*f*) and (*i*); (18) was resistant to (*a*); (19) to (23), inclusive, were strongly attacked or corroded by all products except (*a*) and (*b*). (24) was resistant to (*a*), (*b*), and (*i*). Chalk added to the acid milk product protected the corrosive metals only partially. Decomposition was increased at high temperatures and high acidities.—S. G.

Use of Non-Ferrous Metals in the Food Industry. T. N. Morris, J. M. Bryan, N. D. Sylvester, C. H. Desch, *et al.* (*Chem. and Ind.*, 1933, **52**, 139–143; and (summaries) *Aluminium Broadcast*, 1933, **4**, (2), 2–8; *Met. Ind.*, (*Lond.*), 1933, **42**, 195–196).—A report of a discussion at a joint meeting of the London Local Section of the Institute of Metals and the Food Group of the Society of Chemical Industry. T. N. M. outlined the various uses in the construction of chemical plant for the food industries of silver, copper, tin, nickel, chromium, aluminium, and their alloys. Nickel is considerably corroded by cold citric acid in the presence of oxygen, but Monel metal resembles copper in being resistant to this acid in the absence of oxygen and only slightly attacked in its presence; Monel metal is also resistant to brines, as is also aluminium if a little sodium chromate is added to the brine. Aluminium is useful for handling fatty materials, but nickel and copper should not be used for this purpose since they act catalytically on the fatty acids and produce rancidity. J. M. B. discussed the behaviour of tinplate in buffered citrate solutions; corrosion is negligible in the absence of air but severe in its presence, being greater the higher the p_H and still greater in the presence of ferrous citrate which acts as an oxygen carrier. Abrasion accelerates corrosion of tin but decreases the corrosion of copper and Monel metal. N. D. S. gave an account of the action of nickel on milk, based on the work of McKay, Fraser, and Searle (*Amer. Inst. Min. Met. Eng., Tech. Publ.* No. **192**), and of the use of laboratory tests for ascertaining the value of a metal for resistance to corrosion by foodstuffs. Brief notes on the determination of metallic contamination in foodstuffs are also given. Other speakers discussed the value of silver-lined plant for handling vinegar, essences, and essential oils and the action of gelatin and heating gases on chemical plant.—A. R. P.

***The Corrosive Action of Different Cooling Brines on Individual Metals.** M. Miethke and G. Witt (*Molkerei-Zeit.* (*Hildesheim*), 1934, **48**, 842–843; *C. Abs.*, 1934, **28**, 6416).—Several brines were tested on various metals and compounds to determine their corrosive action. After exposure for 30 days at − 5° C. the change in weight was determined for each metal. The brines, indicated by trade names, were: (1) Reinhartin, 28° (Bé.), containing principally $CaCl_2 \cdot 6H_2O$ and $MgCl_2 \cdot 6H_2O$ in a 1 : 3 ratio, with added protective colloids and buffers; (2) Kühlsoleen, 22°; (3) Kühlsoleen special, 19°, containing $CaCl_2 \cdot 6H_2O$ and $MgCl_2 \cdot 6H_2O$ in a 1 : 3 ratio, with a silicate sediment; (4) Frigisol, 22°, containing $CaCl_2 \cdot 6H_2O$ and $MgCl_2 \cdot 6H_2O$ in a 1 : 3·7 ratio, with Na_2CrO_4 as an anticorrosive; (5) chromate-containing Reinhartin, 27°, similar to (1) but containing Na_2CrO_4; (6) Thermolyt, 22°, a $CaCl_2$ brine; (7) Eissol, 22°, a $CaCl_2$ brine; (8) Frigodur, 22°, a $CaCl_2$ brine; (9) a brine made from commercial $CaCl_2$, 22°; (10) a brine made from commercial $MgCl_2$, 22°; (11) a brine made from commercial NaCl, 22°; (12) Molkereisole, 36°, a carbonate-containing brine with added silicate. The metals tested were: (*a*) V2A welded steel; (*b*) cast iron; (*c*) wrought iron; (*d*) zinced iron; (*e*) zinc; (*f*) soldered tin; (*g*) tinned copper; (*h*) tinned brass; (*i*) chrome copper; (*j*) copper; (*k*) bronze; (*l*) red brass; (*m*) sheet brass; (*n*) cast brass; (*o*) aluminium; (*p*) Anticorodal; (*q*) nickel; (*r*) Nicorros, a nickel alloy; and (*s*) lead. (5) caused little or no corrosive action on any material except lead. (6) to (11) inclusive were especially corrosive to all the metals except (*a*) and (*q*). (1) was corrosive to all materials except (*a*) and (*i*); (2) to all except (*a*), (*h*), and (*q*); (3) to all except (*a*), (*f*), (*g*), (*h*), (*i*), (*q*), and (*r*); (4) to all except (*a*), (*f*), (*i*), (*o*), (*p*), (*q*), and (*r*).—S. G.

***The Action of Cyder on Metals.** Vernon L. S. Charley (*Agric. Hort. Research Sta., Long Ashton, Bristol, Ann. Rep.*, **1933**, 152–174; *C. Abs.*, 1934, **28**, 6874).—Clean strips of metal (10 cm. × 1 cm. × 3 mm.) were suspended in 500 c.c. portions of cyder in such a way that approximately ½ in. of the strip extended above the liquid. The tightly corked bottles were stored in a cool place and the strips and liquids were examined after 2 months. The cyders used were (**I**) sharp cyder containing malic acid 0·7 and tannin 0·2%, (**II**) bitter-sweet cyder containing malic acid 0·25 and tannin 0·49%, and (**III**) acetified cyder containing malic acid 0·36, AcOH 0·30, and tannin 0·18%. Of the pure metals tested, aluminium, silver, and nickel had little or no effect on the flavour and colour of the cyder and were not dissolved by the liquid. Copper, lead, iron, zinc, and gun-metal imparted slight to strong metallic flavours to the cyder, and the liquids usually contained traces to large amounts of the metals; copper was not found in **II**. Tin did not alter the flavour of the cyders but **II** contained traces of the metal. Iron and zinc darkened the cyders to a considerable extent. In other tests in similar conditions, chromium–nickel steels (chromium 8–18, nickel 11–18%) were highly resistant to corrosion by cyders ranging in type from very sharp to bitter-sweet; addition of sulphur dioxide (200 p.p.m.) to sweet cyders increased the corrosion of the steels. Austenitic cast iron, containing chromium 5–8, and nickel 25–30%, was less resistant to corrosion than chromium–nickel steel. Two samples of bronze (95 : 5; 96·5 : 3·5) were highly resistant to corrosion and caused little or no change in the flavour of the cyders. Experiments with tinned copper filters that had been in service for several years indicated that with cyder moving across a sheet of tinned copper, with some of the underlying metal exposed, there is very little danger of serious contamination of the cyder with either metal. Serious contamination occurs when the cyder is left in contact with the filter for some hours.—S. G.

Corrosion-Resistance of Metallic Apparatus in Breweries.—III. P. Schafmeister and W. Tofaute (*Schweiz. Brau.-Runds.*, 1933, **44**, 101–103).—S. G.

***Effect of Alkaline Liquors on Some Alloys.** G. H. McGregor (*Paper Trade J.*, 1932, **94**, (6), 34–36; *C. Abs.*, 1932, **26**, 2590).—A number of ferrous and non-ferrous alloys were subjected for 9 months to the action of various alkaline pulp-mill liquors. Very erratic results were obtained among various samples in a given group, even when exposed to the same alkaline liquor, but, in a general way, it is apparent that the chromium and chromium–nickel alloys are much more resistant to the corrosive liquids than regular cast iron or sheet steel. The non-chromium ferrous materials (including fabricated cast irons), Monel metal, and copper–molybdenum alloys are greatly attacked by the various alkaline liquors. Toward the non-ferrous groups of alloys, the alkaline liquors are very corrosive.—S. G.

***The Problem of Corrosion.** P. Regnauld (*Mem. artillerie franç.*, 1934, **13**, 241–265; *C. Abs.*, 1934, **28**, 6415).—From corrosion tests in humid air, water, and sea-water, it is concluded that for marine architecture, the metals and alloys may be ranked in the following classes with regard to resistance to corrosion: (1) austenitic steels with 18–20% chromium and 7·8% nickel; Monel metal; (2) Vedal metal and Duralumin with or without copper; (3) copper–steels and ferro–nickels containing 33% nickel; (4) Armco iron; (5) low-carbon steels containing 13% chromium. The application of protective coatings is discussed.—S. G.

***Corrosion and Fatigue.** K. Laute (*Mitt. Material., Sonderheft* 25, 1934, 27–36; discussion, 36–37).—Paper read before the third "Korrosionstagung," Berlin, 1933. See *Met. Abs.*, this volume, p. 387.—I. M.

†**Investigations on Cavitation Corrosion.** P. de Haller (*Schweiz. Bauzeit.*, 1933, **101**, 243–246, 260–264; *Eng. Abs.*, 1933, (57), 41–42).—The phenomenon of cavitation and of the corrosion resulting therefrom was first observed in 1894 on the propellers of destroyers; since then cavitation has been noted more frequently. In theory it is assumed that small bubbles of steam, generated at the points of lowest pressure, collect and eventually separate from the wall, leaving an empty space. By rapid condensation of the bubbles, water is precipitated on the walls at a pressure approximating to that which should exist in the absence of cavitation. This was first observed by Ackeret, and formed the basis of his theory. As a result of the phenomenon observed, the vanes or blades of the propeller deteriorated rapidly and exhibited a spongy appearance of the surface, differing, however, from that produced by chemical or electrolytic action. It has been found that chemical action plays a minor part in the destruction. Parsons demonstrated that water-hammer very rapidly destroys membranes of any metal. It is difficult, however, satisfactorily to explain forces which would bring about destruction of the

material in the case of cavitation. Recent investigations indicate that in certain conditions the high pressures considered essential are not necessary to cause this destruction. Pelton wheels, running at high speeds, exhibit corrosion similar to that on the vanes of Francis turbines, where it can reasonably be attributed to cavitation; but as the water strikes the concave sides of the buckets of the Pelton wheel, where no negative pressure can occur, the corrosion must be attributed to the direct hammering or shock of the water which is dispersed on the surface in the form of spray. In 1927 Honegger investigated this effect with an apparatus consisting of studs of different materials fixed to the periphery of a disk rotating at a very high speed. The studs were thus exposed to a thin jet of water in rapid succession under a pressure of 131 ft. The effect on them decreased rapidly with velocity of rotation of the disk, but increased with size of the jet or of the drops. The vibrations caused by constant hammering by the jets appeared to have no influence on the deterioration. The destructive action of water in the form described was first discovered in steam-turbines on the blades of the last stages working in saturated steam, which were most frequently seriously corroded. Experiments with an apparatus constructed to produce cavitation indicated a distinct similarity in behaviour of different bronzes and steel castings exposed to cavitation; but the bronzes exhibited much less resistance to water-hammer than the steel castings in the case of cavitation. Results of a number of investigators indicate that corrosion by cavitation is mainly attributable to mechanical action; little is known of the nature and amount of the forces to which the material is exposed, and especially the pressure occurring in the zone of cavitation, which could be measured only by means of a piezo-quartz cell, of which a description is given. A *bibliography* is appended.—S. G.

***Corrosion and Cavitation.** H. Schröter (*Z.V.d.I.*, 1933, **77**, 865–869).—The tests were carried out with a special apparatus built into the emptying stage of the Walchensee power works. The apparatus consists of a pressure-measuring device and a jet with interchangeable walls made of the materials under investigation which are selected according to their suitability as indicators of corrosion, *i.e.* they are readily corrodible. Lead has given the best results. At points of condensation impact by the action of the water speed, cavities, shallow depressions, and eventually holes are formed, the depth of which increases rapidly when the side-walls have been destroyed. The resistance to cavitation is then determined by the loss in weight, and is dependent on the hardness and toughness of the material. No theoretical explanation is given but further experiments are being carried out.—K. S.

***Material Destruction by Cavitation Erosion.** H. Schröter (*Z.V.d.I.*, 1934, **78**, 349–351).—Test plates were subject to high water-speeds at the Walchensee power works. A propeller bronze was attacked six times as severely as V2A steel, but rubber and rubberized fabric coatings afforded adequate protection.
—v. G.

***Metallographic Investigations on the Problem of Cavitation Erosion.** H. Schröter (*Z.V.d.I.*, 1934, **78**, 1161–1162).—Cf. preceding abstract. Micrographic examination of failures in metals due to cavitation erosion has been made in an attempt to elucidate the nature and causes of the failures. Examples are discussed.—K. S.

The Phenomena of Corrosion. J. Liger (*Galvano*, **1934**, (27), 24–26; (28), 17–19).—See *Met. Abs.*, this volume, p. 426. A general discussion.—E. S. H.

***Investigation of the Process of Mutual Displacement of Metals.** N. Isgarischev and I. Mirkin (*Korrosion u. Metallschutz*, 1934, **10**, 109–112).—The replacement of copper, cadmium, lead, nickel, iron, and cobalt from their solutions by metallic zinc in the presence of various anions has been investigated, and the very important part played by hydrogen evolution in neutral solutions has been established, especially in the presence of iron, cobalt, chromium, and chlorine ions. The phenomena observed are explained by the different overvoltages of hydrogen in the presence of metals which form a couple with zinc, and their importance in the study of corrosion problems is indicated. —A. R. P.

***Methods of Studying the Corrosion of Metals and Alloys at Elevated Temperatures by Gases, and Their Applications.—I.–III.** A. Portevin, E. Prétet, and H. Jolivet (*Rev. Mét.*, 1934, **31**, 101–115, 186–191, 219–236).—(I.—) The methods are discussed under the headings: weighing methods; volumetric methods; measurements of electrical resistance; endurance (to rupture) method; for quantitative and qualitative work methods are described. The oxidation–temperature law is discussed fully. (II.—) Mechanism of oxidation of alloys is discussed. Preliminary experiments to ascertain the best conditions for use in the investigation are described. Specimens of cylindrical form are used. The apparatus used is described and illustrated by working diagrams. As a check on the apparatus a series of tests were made with observation of gain in weight and volume of gas absorbed, the recorded values showing satisfactory concord. (III.—) Results of tests are given in the form of oxidation–temperature curves for electrolytic iron, mild steel, iron–aluminium, iron–chromium, and iron–silicon alloys, and observations on microscopic examination of the samples are given. Results obtained on electrolytic iron confirm those of Pilling and Bedworth and appear to show some irregularity at the commencement attributed to initial condition of the specimens and a slight variation in the oxidation properties of the metal and oxide at the $\alpha \longrightarrow \gamma$ transformation, the rate of oxidation being more rapid in the γ range. The binary alloys of low alloy content also show an anomaly at the $\alpha \longrightarrow \gamma$ transformation. The protection observed in resistant alloys appears to be due to a protective film of the oxide of the alloyed element.—H. S.

Corrosion Tests for Electroplates. R. J. Piersol (*Metal Cleaning and Finishing*, 1934, **6**, 169–172, 175; *C. Abs.*, 1934, **28**, 4360).—Different methods of testing the relative corrodibility of various electroplated metals are described. —S. G.

V.—PROTECTION

(Other than Electrodeposition.)

(Continued from pp. 502–505.)

The Protection of Light Metals and Alloys Against the Corrosive Action of Salt Solutions. Georges Vie (*Industrie chimique*, 1934, **21**, 330–331; *Chem. Zentr.*, 1934, **105**, II, 1365).—The value of enamels, colours, and lacquers for the protection of aluminium and its alloys is briefly discussed. The porosity of aluminium castings can be reduced by immersing them in hot sodium silicate solution (*d* 1·08). Chromate solutions containing heavy metals produce only a thin protective film on aluminium alloys. Painting with cellulose or oil paints containing an alkaline earth chromate pigment affords satisfactory protection against sea-water; similar protective films are produced by coating the metal with soap or vegetable oils and heating to carbonize the organic material. Various immersion solutions for producing artificial oxide films are described. —A. R. P.

†**The Anodic Oxidation of Aluminium and Its Alloys.** S. Wernick (*J. Electrodepositors' Tech. Soc.*, 1934, **9**, 153–176).—A detailed account is given of various methods of producing protective oxide films on aluminium and its alloys, of the theory of the oxidizing process, of methods of dyeing and colouring the film, of methods of testing the porosity and thickness of the film, and of the physical, chemical, and electric properties of the film. Tests on numerous films indicate that the hard, brittle type is more resistant to cor-

rosive influences than the relatively soft, ductile type, the optimum thickness is about 0·002 cm., the protection afforded by the film is considerably enhanced by filling the pores with lanoline or other grease, the complete expulsion of the electrolyte from the pores is essential for good corrosion-resistance, and for the production of good colour effects the film should be dyed immediately after formation, using slightly acid dyestuffs. The breakdown voltages of unimpregnated films under 50 cycles a.c. are of the order of 600–950 v., and of films impregnated with waxes or synthetic resins about 2000 v. The light-reflecting powers of suitably anodized aluminium are superior to those of chromium-plate. Various practical applications of the process are considered. —A. R. P.

***Properties of the Layer of Oxide Formed by Anodic Polarization at the Surface of Oxidizable Metals.** M. Marinescu (*Bull. Soc. Romåne Fiz.*, 1933, **35**, 135–142; and (abstract) *Ann. Post. Télég. Téléph.*, 1933, **22**, 546; *Brit. Chem. Abs.*, **1934**, [A], 258).—The anodic resistance of certain oxidizable metals such as aluminium and tantalum is high owing to the adsorption of oxygen by the layer of oxide formed at the anode. A mathematical explanation is advanced of experimental results which have been obtained with a.c. of high and low current density.—I. M.

***Electrolytic Oxidation of Aluminium by Means of High-Frequency Alternating Current.** A. F. Valter, S. S. Gutin, T. G. Lapunzova, and D. V. Stepanov (*Zhurnal Fizicheskoy Khimii* (*J. Phys. Chem.*), 1933, **4**, (3), 295–298).—[In Russian.] See *J. Inst. Metals*, 1933, **50**, 636. Experiments were carried out with frequencies of 500, 13,000, and 10^6 cycles/second in dilute sulphuric and oxalic acids. The results obtained at 500 cycles/second do not differ markedly from those obtained at the usual industrial frequency (50 cycles/second). The properties of the film depend on the current density and electrode voltage. With 0·005–0·05 and also with about 0·5 amp./cm.^{2} a uniform film is obtained at 350–400 v., but between 0·05 and 0·5 amp./cm.^{2} a uniform film is unobtainable. Voltages between 50 and 200 v. have little effect. Electrolysis of narrow strips of aluminium at 2·5–3 amp./cm.^{2} at 13,000 cycles/second can be carried out without a preliminary oxidation at 50 cycles/second, and produces a uniform grey film. The elasticity of such films, qualitatively, appears to be greater. Experiments at 10^6 cycles/second gave no positive results.—N. A.

***Investigation of Protective Coatings on Magnesium and Aluminium Obtained with the Aid of Molten Oxidizing Agents.** I. V. Krotov and G. G. Ivanov (*Legkie Metally* (*Light Metals*), **1934**, (4), 36–38).—[In Russian.] The corrosion-resistance of oxide films on aluminium and magnesium produced by immersion in molten salts has been determined in a 3 : 1 mixture of 3% sodium chloride solution and 30% hydrogen peroxide and in plain 3% sodium chloride solution, respectively. The best salt mixture was found to be sodium nitrate 84, potassium nitrate 66, and potassium dichromate 5 grm. at 350° C.; before immersion the metal should be cleaned in hydrofluoric acid.—D. N. S.

The Anodic Oxidation of Aluminium and Its Alloys for Protection and Decoration. George O. Taylor (*Metallurgia*, 1934, **10**, 173–176).—Anodic oxidation by the chromic acid and sulphuric acid processes are discussed as well as the general properties of the anodic film as regards thickness, adhesion, structure, strength, and resistance to corrosion. Consideration is given to the alloys suitable for treatment by the two processes and to the influence of the alloying constituents in controlling the natural colour of the oxide film. The treatment of castings and of wrought materials for the production of utility and decorative finishes is dealt with, and also the types of decorative finishes available by both processes. The impregnation of plain finishes and of coloured finishes, and the practical applications of the process in architecture and decoration and in industry are also fully considered.—J. W. D.

The M.B.V. Surface Treatment for Aluminium and Its Alloys, and Its Applications in the Chemical Industry. Anon. (*Alluminio*, 1934, 3, 89–91).—Eckert's modification of the Bauer–Vogel process is described.—G. G.

***On the Protective Value of Electrolytic Metallic Coatings of Nickel and Chromium.** F. Pietrafesa (*Metallurgia italiana*, 1934, **26**, 322–330).—A metallographic and physical study of the resistance to corrosion of chromium- and nickel-plated test-pieces of various metals and alloys. The influence of surface defects, accelerated corrosion tests, and methods of determining resistance to corrosion are discussed.—G. G.

***Tin–Iron Alloy in Tinplate, with Some Notes on Some Imperfections.** W. E. Hoare (*J. Iron Steel Inst.*, 1934, **129**, 253–264; discussion, 265–271).—See *Met. Abs.*, this volume, p. 305.—S. G.

The Manufacture of Tinplate. Geo. Genin (*Industrie chimique*, 1934, **20**, 802–804, 886–889).—Present practice is described and discussed.—S. G.

***The Behaviour of Coloured Zinc Sheets in Alternating Immersion Tests.** W. Beck and E. Völker (*Z. Metallkunde*, 1934, **26**, 56–61).—Zinc sheets were coloured by immersion in solutions of ferric chloride, ammoniacal copper salts, manganese salts, chlorates, or ammonium molybdate, and their resistance to corrosion in the atmosphere and under alternate immersion in 5% sodium chloride containing 1% of hydrogen peroxide has been determined gravimetrically. Films containing molybdenum compounds considerably retard the rate of corrosion of zinc. Measurements have been made of the p_H values of the colouring baths and experiments on their regeneration are described.—B. Bl.

***Chemical Methods of Testing Zinc-Coated Iron.** S. A. Pogodin and M. S. Guseva (*Metallurg* (*Metallurgist*), **1932**, (10–11), 25–32; (12), 3–12).—[In Russian.] The comparative study of chemical methods of testing zinc-coated iron indicates that the Preece test is characteristic of neither the thickness of the zinc layer, nor of its resistance to corrosion, and serves only as an estimate of its uniformity, but not its quality. Only the methods of Opperle and Bauer can be recommended for general acceptance and control tests. Opperle's method requires less time, whilst Bauer's method is more convenient, both giving closely similar results. For a qualitative estimation of the resistance to corrosion of electrodeposited zinc coatings Wernlund's test is useful.—N. A.

***Effect of Pickling and Galvanizing on the Strength Properties of Drawn Steel Wire.** H. van der Loo, W. Pungell, and E. H. Schulz (*Stahl u. Eisen*, 1931, **51**, 1585–1590; *Bull. B.N.F.M.R.A.*, 1932, (**40**), 12).—A study of the effect of pickling in hydrochloric and sulphuric acids of differing concentrations and temperature, of annealing, and of galvanizing on the tensile strength, elongation, bending value, &c., of steel wires of varying degree of cold-work. The conclusions reached are with regard to practice. Slight brittleness due to pickling is obviated by annealing action occurring on galvanizing. In order to obtain good bending properties, &c., wire to be galvanized should be drawn with the highest possible degree of cold-working. —S. G.

Getting the Facts About Zinc Coatings. George C. Bartells (*J. Amer. Zinc Inst.*, 1934, **15**, 52–60).—The testing of galvanized coats on roofing material, the use of zinc paint on rusted material, and the analysis of the weight of coatings on galvanized sheets and fencing wire are discussed. —J. H. W.

Protective Treatment of Ferrous Pipe. Thomas B. Downer (*J. Amer. Water Works Assoc.*, 1933, **25**, 605–632; and (abstract) *Mech. World*, 1933, **94**, 1250).—Zinc galvanizing affords little protection underground. Copper service pipes should be used for all small sizes except for inactive waters and well-drained soil.—S. G.

Electrolytic Galvanizing of Steel Sheet and Strip. Anon. (*Galvano*, **1934**, (27), 26–29).—The advantages of the electrolytic and hot-galvanizing methods are compared.—E. S. H.

Corrosion and Hot-Galvanizing of Iron and Steel. Allan B. Dove (*Wire and Wire Products*, 1934, 9, 298–302, 350).—Read before the Wire Association (U.S.A.). The theoretical and practical galvanizing of wire, with particular reference to the mechanism of corrosion, is discussed, especially as regards the most satisfactory type of flux, the substitution of a tri-base flux for iron chloride, the effect of time of immersion on the thickness of the zinc coat, the use of a suitable covering for galvanizing and tinning pans to reduce ash production, and welding wires for galvanizing.—J. H. W.

Hot-Galvanizing. Use of Sal Ammoniac. A. Forny (*Galvano*, **1934**, (28), 29–30).—Discusses the advantages of the use of sal ammoniac as a flux. —E. S. H.

Hot-Galvanizing Pots. A. Forny (*Galvano*, **1934**, (29), 17–19).—A general discussion.—E. S. H.

Australian Standard Specification for Zinc-Coated (Galvanized) Sheets (Plain and Corrugated) (A 20–1934). —— (*Standards Assoc. Australia*, **1934**, 8 pp.).—S. G.

Australian Standard Methods of Determining the Weight of Coating on Zinc-Coated (Galvanized) Articles. Part I.—Sheets. —— (*Standards Assoc. Australia*, **1934**, 9–11).—Appendix to specification A 20–1934; see preceding abstract.—S. G.

A New Apparatus for the Determination of the Zinc Coating on Galvanized Wires. A. Keller and K. A. Bohacek (*Draht-Welt*, 1932, **25**, 547–549).—An apparatus for determining the amount of Zn on galvanized wires by measuring the volume of H_2 evolved when the metal is immersed in dilute acids is described and illustrated. It consists of a dissolution flask connected with a measuring burette and a levelling device, the acid itself acting as the confining fluid. For every c.c. of H_2 collected at N.T.P. 2·91 mg. of Zn are dissolved; for ordinary works' practice, however, sufficiently accurate results can be obtained by making the test at 20° C. and multiplying the volume of H_2 collected by 2·72 to obtain the mg. of Zn on the specimen.—A. R. P.

Control Testing of Metallic Coatings. R. B. Mears (*J. Electrodepositors' Tech. Soc.*, 1934, 9, 43–56).—Control testing is necessary when working to specification. A statistical method of control is described based on the weight of metal deposited. The weight of nickel on steel can be determined by a cyanide stripping method; that of copper on nickel or steel by a sodium polysulphide method.—S. W.

Metal Spraying: New Methods, Apparatus, and Uses. Fritz Markhoff (*Maschinenbau*, 1934, **13**, 381–384).—The construction of various types of pistol, the technique of the spraying process, and its applications are discussed. —K. S.

Re-Surfacing of Corroded and Worn [Oil] Refinery Equipment [by Metal Spraying]. H. R. Leland (*Oil and Gas J.*, 1934, **32**, (48), 12; *J. Soc. Petrol. Tech.*, 1934, **20**, 371A).—Improvement in the speed of spray guns has led to a considerable development in the metallization of corroded and worn refinery equipment. Besides aluminium, lead, tin, cadmium, zinc, copper, and the higher melting point metals, KA_2 stainless steel, high-carbon steels, bronze, and Monel metal can be applied successfully. The interiors of Dubbs' reaction chambers after cleaning and sand-blasting have been metallized with aluminium, providing complete protection against corrosion by hydrogen sulphide. Corroded boiler water tubes have been successfully protected with aluminium, and lead linings applied to acid contact tanks. A coating of 18–8 chromium–nickel steel has also been applied to rebuilt plungers after undercutting and blasting with steel grit, finally grinding and polishing to exact diameter. Vertical sections on the inside of floating-roof storage tanks and the shoes attached to the decks have been coated with zinc to prevent discoloration of distillates and gasoline from rust.—S. G.

Metallic Cementation. II.—Cementation of Some Metals by Means of Antimony Dust. Tsutomu Kase (*Kinzoku no Kenkyu*, 1934, **11**, (5), 251–262). —[In Japanese.] The cementation of iron and copper by means of antimony dust was investigated at various temperatures between 350° and 1000° C. The depth of penetration, microstructure, chemical analysis, and corrodibility by some acids were measured for the surface layer of the cemented specimens. (*a*) Antimony diffuses into iron at temperatures over 350° C., and the rate of diffusion increases as the temperature increases. The relation between the increase in weight of the specimen, or the depth of penetration, and the temperature of cementation is given by an exponential function, which shows a break at the melting point of antimony. Similarly, the relation between the increase in weight of the specimen and the duration of cementation is also given by an exponential function. The cemented surface has a good resistance to 10% sulphuric acid or hydrochloric acid. (*b*) The diffusion of antimony into copper is peculiar. In temperatures from 350° C. to the melting point of antimony, 630° C., copper diffuses into antimony, and the weight of the specimen decreases, but from 630° C. upwards, antimony diffuses into copper, and the weight of the specimen increases. The relation between the decrease or increase of the weight of the specimen and the temperature of the cementation is given by an exponential function, which shows a break at the melting point of antimony. Similarly, the relation between weight increase of the specimen and the duration of cementation is also given by an exponential function.—S. G.

Prevention of Scaling-Off of the Enamel on Copper Wire. Kiyoshi Shirato (*J. Electrochem. Assoc. Japan*, 1934, **2**, 122–125; *C. Abs.*, 1934, **28**, 4804).—[In Japanese.] Copper wire covered with cupric oxide is suitable for enamelling and rubber coating. This oxide film formed before enamelling on copper wire absorbs sulphur evolved during the vulcanization process from the rubber mixture, and about 40% sulphuration of cupric oxide does not cause the sulphide film to fall off. The sulphur vapour, though hindered by the enamel layer, passes through to a considerable extent; the amount of cupric sulphide thus formed in the oxide layer is, however, far too small to cause scaling-off. Tin film on copper wire behaves as does cupric oxide and absorbs the sulphur vapour to form SnS. This scales off more readily than does cupric sulphide. —S. G.

The Cleaning of Condenser Tubes. Konrad Weiss (*Maschinenschaden*, 1933, **10**, 2–7; *C. Abs.*, 1934, **28**, 6221).—The removal of deposits of boiler scale in condenser tubes is explained in detail on the basis of laboratory experiments. The production of the scale is favoured by electrolysis. Advantages of the use of hydrochloric acid over mechanical cleaning are pointed out. —S. G.

Prevention of Sulphide Corrosion in Gasoline Plants. J. C. Albright (*Nat. Petrol. News*, 1934, **26**, (4), 29–34; *J. Inst. Petrol. Tech.*, 1934, **20**, 255A).—In refinery plant it has been found that the complete elimination of corrodible metal by stainless steel, pure aluminium, and Admiralty metal has reduced the loss, due directly and indirectly to corrosion, to a satisfactory low limit. The considerable extra initial cost has been compensated by the saving effected.—S. G.

[Petroleum] Tank Coatings. Brian Mead (*Indust. and Eng. Chem.*, 1932, **24**, 857–859).—Defines 13 requirements of a protective coating for the vapour space of petroleum tanks, and summarizes the results with different materials. —S. G.

Effect of Organic Coatings on Metal Subjected to Stress and Corrosion. F. N. Speller and I. B. McCorkle (*Oil and Gas J.*, 1933, **32**, (23), 73; *J. Inst. Petrol. Tech.*, 1934, **20**, 15A).—The most attractive way to protect metals against corrosion is by the application of paints, either by spraying, dipping, or brushing. A number of tests was carried out, and the results show that a paint film will definitely increase the life of a metal subject to corrosion-fatigue, but that the protective power of the coating is liable to be greatly diminished under cyclic strain.—S. G.

Recent Progress in Mitigating Soil Corrosion. G. N. Scott (*Amer. Petrol. Inst. Prod. Bull.*, 1933, (**212**), 130; *J. Inst. Petrol. Tech.*, 1934, **20**, 226A).—This report covers the developments and improvements in pipe-protection practice, since the formation of the American Petroleum Institute's corrosion committee in 1928, which have resulted in saving to the industry and an indirect saving to every consumer of oil, gas, or water. These developments are: (1) the recognition of the importance of proper application of coatings; (2) the discovery of soil stress; (3) the classification of coatings as to behaviour through nation-wide tests of protective coatings; (4) the development of methods of examining coatings; (5) the introduction of ways of forecasting the corrosive effects of soils; and (6) the better understanding of the phenomenon of pitting in relation to the properties of the soil, the time and surface extent of exposure. Further improvement may be anticipated through (1) metallurgy; (2) improved use of present materials; (3) standardization of tests on protective coatings; (4) development of a routine procedure for soil-corrosion surveys; (5) further study of the effects of corrosion, especially with reference to the relation between test data and field experience; (6) cathodic polarization; and (7) better application of economic principles. All these activities or fields for study should be focussed on the preparation of a comprehensive manual on pipe corrosion. For the immediate future it is recommended that the Institute continue the field coating tests because of their great importance in connection with the fundamental engineering principles involved in the design and selection of protective coatings.—S. G.

Effect of Severe Winter Weather on Adhesion of Paint Films. Francis M. Hartley, Jr. (*Dutch Boy Quarterly*, 1934, **12**, (3), 18–19).—The peeling of paint from metal surfaces due to unequal expansion and contraction is discussed. —E. S. H.

VI.—ELECTRODEPOSITION

(Continued from pp. 505–508.)

***Electrodeposition of Aluminium from Non-Aqueous Solutions.** R. D. Blue and F. C. Mathers (*Trans. Electrochem. Soc.*, 1934, **65**, 339–352; discussion, 352–355).—For abstract of the paper, see *Met. Abs.*, this volume, p. 134. In the discussion R. D. B. stated that with a 15% zinc–aluminium alloy anode the cathode deposit had the same composition, but with a 10% copper–aluminium alloy anode the deposit contained 10–20% copper. *Daniel Gray* reported that from cyanide solutions containing a 50 : 1 indium–silver ratio deposits could be obtained containing from 0 to 60% of indium by varying the current density. *Alfred von Zeerleder* said that from fused chloride baths the aluminium deposits rapidly treed and that he had observed a similar effect with the organic bromide bath described by B. and M.; the cathode current efficiency of the latter bath was 91% and the anode efficiency 106%, both electrodes evolved gas, and the conductivity of the bath decreased with use. R. D. B. replied that treeing occurred only at low current density and that darkening of the bath and fall in conductivity did not occur when anode corrosion was good. F. C. M. stated that electrodeposits of aluminium afforded only poor protection of iron against the salt-spray but afforded good protection of copper against thermal oxidation.—A. R. P.

Influence of Several Added Ingredients, Especially Alkaloids, on Electrolytic Deposits of Cadmium, Zinc, and Tin. —— Guerillot (*Bull. Soc. Franç. Élect.*, 1934, [v], **4**, 1167–1178).—In a study of the effects of bodies of vegetable origin, particularly of alkaloids, on the brightness, coherence, and protective quality of electrolytically deposited cadmium, zinc, and tin, it became apparent that actual plant extracts were more effective than were artificially produced materials also used by G. He therefore appeals for investigation of this phenomenon in large-scale practice.—P. M. C. R.

The Intermediate Layer Patent in Chromium Plating. Herbert Kurrein (*Metallwirtschaft*, 1933, **12**, 194).—The patentability of the idea of an intermediate layer of nickel or other metal between the chromium plate and the basis metal is discussed with reference to German patent law and to a decision in recent litigation.—A. R. P.

***On the Electrolytic Deposition of Chromium from Chromic Acid Electrolytes.** Franz Josef Weber (*Oberflächentechnik*, 1934, **11**, 123–127).—The nature of chromium deposits made from baths containing 50 and 200 grm./litre of chromic acid at 20° and 40° C. with current densities of 5, 10, and 15 amp./dm.^{2} has been determined using sulphuric, phosphoric, or boric acids as addition agents. Bright deposits were obtained at 20° C. in baths containing as much as 5% of sulphuric acid using a current density of 7·5 amp./dm.^{2}, hence the limit of 1·2% of SO_4'' in the bath prescribed by Liebreich and others does not exist. Bright deposits, but with very low current efficiencies, can also be obtained from baths containing as much at 25% of phosphoric acid; addition of this acid to the usual chromium plating bath considerably reduces the current yield. Addition of boric acid, however, increases the current yield of chromic acid baths containing about 1% of sulphuric acid; in the absence of the latter the amount of boric acid necessary to produce bright deposits is about 90% of the amount of chromic acid present, and the current yield is only about half that obtained with 1% of sulphuric acid. Low plating temperatures and additions of ammonium sulphate produce harder deposits.—A. R. P.

***On the Electroplating with Chromium from Aqueous Chromic Acid Solutions Containing Hydrofluoric Acid.** Erich Müller and Herbert Drechsel (*Z. Elektrochem.*, 1934, **40**, 707–713).—Comparative tests showed that the substitution of hydrofluoric acid for the usual sulphuric acid in chromium plating has many advantages. The contact resistance which occurs with pure lead anodes can be prevented if the lead is alloyed with antimony. Hence provided that no unforeseen complications ensue in continuous operation, it is predicted that in the future chromium plating will be effected in fluoride-containing solutions.—J. H. W.

Note on Chromium Plating of Printing Plates. J. G. Roberts (*Trans. Ceram. Soc.*, 1934, **33**, 213–214).—By varying the current density, temperature of bath, and time of deposit more durable coatings of chromium on printing plates have been obtained.—S. V. W.

Chromium Plating of Moulds for Glass. Jan Korecky (*Sklářské Rozhledy*, 1933, **10**, 23–24; *Chem. Zentr.*, 1934, **105**, II, 505).—Chromium-plated metal moulds give a much better finish to moulded glass articles and have a longer life than unplated moulds. The chromium layer should be 0·002–0·003 mm. thick with a 0·001 mm. thick undercoating of nickel; with 60–80 amp./dm.^{2} at 35°–40°, the necessary chromium deposit is produced in 10–15 minutes.
—A. R. P.

Nickel–Chromium Plating Technique. Maurice Cook and B. J. R. Evans (*J. Electrodepositors' Tech. Soc.*, 1934, **9**, 125–135; and *Met. Ind.* (*Lond.*), 1934, **44**, 279–281, 329–331; discussion, 377).—A detailed account is given of the various steps in the preparation, cleaning, and plating of large and small ferrous and non-ferrous metal articles in a works making cycle and motor accessories. The steps include degreasing with trichlorethylene, electrolytic cleaning in a hot solution containing potassium carbonate 46, sodium silicate 2, caustic soda 12–13, trisodium phosphate 13 grm./litre, anodic etching in sulphuric acid (d 1·7) at 16° C., nickel plating in a bath containing nickel 50, chloride 7·5, boric acid 20 grm./litre (p_H 5·5–5·7), and chromium plating in a bath containing 250–280 grm./litre of chromic acid and a $CrO_3 : SO_3$ ratio of 130 : 1. Racking frames are rubber coated, and have a very long life. Data on the operation of the various solutions over a period of 30 months are given, partly in the form of graphs, and the causes and prevention of defects in the plate are discussed.—A. R. P.

†**Chromium Plating of Metals.** G. Elssner (*Z.V.d.I.*, 1934, **78**, 415–421).—The properties, preparation, and uses of chromium plate are summarized. —v. G.

Electrolytic Chromium Plating. N. P. Labin and L. N. Holtz (*Trans. State Inst. Appl. Chem.*, No. **17**, 1933, 121 pp.; *C. Abs.*, 1934, **28**, 3986).—[In Russian.] A review of the theory and practice of chromium plating, with 149 references to the literature and a long list of patents.—S. G.

Diffusion on Copper-Plated Zinc-Base Die-Castings. Wilhelm F. Castell (*Monthly Rev. Amer. Electroplaters' Soc.*, 1934, **21**, (3), 7–12; discussion, 12–16).—See *Met. Abs.*, this volume, p. 506.—A. R. P.

***Concentrated Cyanide Copper Plating Baths.** L. C. Pan (*Monthly Rev. Amer. Electroplaters' Soc.*, 1934, **21**, (3), 26–29).—With a standard copper concentration of 1 grm.-mol. (63·57 grm.) per litre and a constant content of sodium carbonate (43 grm./litre) the current efficiency at the cathode decreases from 95% with 0·15 grm./litre of free cyanide to 20% with 42 grm./litre, whilst that at the anode increases from 43 to 96% in the same range. With constant free cyanide content and increasing sodium carbonate anodic polarization decreases rapidly to a minimum at 5·5 oz./gall. of carbonate, and then remains constant. A bath containing copper cyanide 12, free cyanide 1·1, and sodium carbonate 10·4 oz./gall. operated at 22° C. with 18 amp./ft.^{2} gives a current efficiency of 75·5% at the anode and 95% at the cathode, the respective polarizations being 1·55 and 0·85 v.; the throwing power of the bath is 47·4%, the deposits are smooth and matt, and the rate of deposition is about double that of the usual acid copper sulphate bath.—A. R. P.

Practical Plating. The Deposition of Copper: Copper Cyanide. E. A. Ollard and J. W. Perring (*Met. Ind.* (*Lond.*), 1934, **45**, 277–279).—The theory of the working of the copper cyanide bath, the composition of the solutions, the operation of the baths, and the control of the solutions are briefly discussed. —J. H. W.

Practical Plating. Deposition of Copper. II.—Acid Copper Solution. E. A. Ollard (*Met. Ind.* (*Lond.*), 1934, **45**, 423–424).—The theory of the action of the acid solution used to build up fairly thick copper deposits is explained, and the action of addition agents such as glue and phenol-sulphonic acid, is described. The preparation and acid content of the solution and the use of phenol-sulphonic acid, which is recommended as an addition agent, are discussed.—J. H. W.

Coppering and Nickeling of Aluminium. O. F. Levitzkaya and M. G. Popova (*Ukrainskii Khemichnii Zhurnal* (*J. Chim. Ukraine*), 1933, **8**, 381–385; *Brit. Chem. Abs.*, **1934**, [B], 679).—[In Ukrainian, with German summary.] Adherent films of nickel, but not of copper, can be deposited electrolytically on aluminium. Aluminium may be coppered by first depositing a thin layer of nickel, and then copper-plating as usual.—S. G.

***The Electrodeposition of Copper, Nickel, and Zinc from Cyanide Solutions.—I.** Charles L. Faust and G. H. Montillon (*Trans. Electrochem. Soc.*, 1934, **65**, 361–374; discussion, 375).—For abstract of the paper, see *Met. Abs.*, this volume, p. 308. In the discussion *F. C. Mathers* expressed the opinion that the deposition of nickel from the complex cyanide bath is due to the alloying effect of the nickel and copper. *William Blum* said it was a similar action to that which occurred in the deposition of sodium in mercury cathodes. —A. R. P.

***Electrochemical Properties of Germanium.** J. Ivan Hall and Alfred E. Koenig (*Trans. Electrochem. Soc.*, 1934, **65**, 215–218; discussion, 219).—See *Met. Abs.*, this volume, p. 185.—S. G.

***The Deposition of Indium from Cyanide Solutions.** Daniel Gray (*Trans. Electrochem. Soc.*, 1934, **65**, 377–380; discussion, 381–383).—For abstract of the paper, see *Met. Abs.*, this volume, p. 308. In reply to the discussion, G. said that 42% of indium alloyed with silver just prevented attack by alkaline sulphides. Alloys of silver with 7·5% indium were " creamy " white, with 20% indium yellow, and with more than 40% indium bluish. The 40% indium alloy was hard and brittle. When gold and indium were plated alternately on silver and the article heated it developed a beautiful sky-blue colour. Diffusing of silver, indium, and palladium layers at 816° C. yielded a fine rose-pink alloy. More than 50,000 oz. of indium per annum could be supplied, if necessary, at a price lower than that of gold.—A. R. P.

***Ductility and Adhesion of Nickel Deposits.** F. P. Romanoff (*Trans. Electrochem. Soc.*, 1934, **65**, 385–400; discussion, 400–401).—For abstract of the paper, see *Met. Abs.*, this volume, p. 308. In the discussion *H. S. Luken* claimed that the softest nickel deposits were obtained from a bath containing a high concentration of nickel chloride together with some sodium chloride, but no sulphate at all. When a thin sheet of electrolytic nickel coated on one side with collodion was polarized as a cathode in dilute sulphuric acid it tended to curl up and was extremely brittle, but when subsequently polarized as an anode it became so soft that it could be tied into a knot.—A. R. P.

Some Remarks on the Part Played by p_H Value in Nickel Plating, and on Obtaining Bright Electrolytic Deposits of Nickel. M. Ballay (*Bull. Soc. Franç. Élect.*, 1934, [v], **4**, 1113–1136).—The range of p_H value through which bright deposits are obtainable may be increased to 3·5–10·0 by suitably modifying the electrolyte by the addition of such materials as the citrates, which hinder the formation at the cathode of insoluble basic materials. It may be assumed that such bright deposits are due to the presence, in the neighbourhood of the cathode, of colloidal materials; the formation of these is found to depend largely on current density. The separate and collective influences of p_H and current density on nickel deposits are discussed and illustrated, as are the effects of such additions as cadmium, sodium, or ammonium sulphate, albumen, starch, dextrin, gum arabic, and gelatine, and of variations in their concentration.—P. M. C. R.

***Influence of Composition and Acidity of the Electrolyte on the Characteristics of Nickel Deposits.** D. J. Macnaughtan, G. E. Gardam, and R. A. F. Hammond (*J. Electrodepositors' Tech. Soc.*, 1934, **9**, 1–26).—See *J. Inst. Metals*, 1933, **53**, 707.—S. G.

British Standard Specification for Nickel Anodes (for Electroplating). —— (*Brit. Stand. Inst.*, No. **558**, 1934, 9 pp.).—S. G.

Automatic and Semi-Automatic Installations for the Electrodeposition of Nickel and Chromium. Anon. (*Galvano*, **1934**, (29), 20–25).—The lay-out of plant is discussed.—E. S. H.

***The Electrodeposition of Tin from Sodium Stannate Solutions with the Use of Insoluble Anodes.** A. W. Hothersall, S. G. Clarke, and D. J. Macnaughtan (*J. Electrodepositors' Tech. Soc.*, 1934, **9**, 101–124; and *Met. Ind.* (*Lond.*), 1934, **44**, 471–472, 517–520).—Sodium stannate solutions have a very high throwing power and high cathode current efficiency but produce poor deposits when stannite is present; with a tin anode the tin concentration of the solution can be kept constant and the formation of stannite avoided only under critically controlled conditions of anode current density, sodium hydroxide concentration, and temperature. With a solution containing 10 grm. of sodium hydroxide per litre, tin dissolves completely as stannite at current densities up to 2·5 amp./ft.^{2} and at temperatures above 70° C.; at lower temperatures or higher current densities the proportion of stannate formed increases. Addition of sodium acetate improves the anode efficiency especially at low temperatures and makes the behaviour of the anode more constant and reproducible. When insoluble anodes are used it is necessary to regenerate the electrolyte from time to time; this cannot be done by addition of sodium stannate, since thereby the alkalinity of the bath is slowly increased, but it can be done by electrolytic dissolution using a steel cathode in sodium carbonate solution in a porous pot immersed in the stannate solution, and a tin and steel anode connected to separate circuits so that twice as much current is supplied to the steel as to the tin anode to oxidize the stannite formed at the tin anode. The following conditions are recommended for operating baths with insoluble anodes: electrolyte, tin (as sodium stannate) 85, sodium hydroxide 15–20 grm./litre; temperature 70°–75° C.; current density preferably 15–20 amp./ft.^{2}; time of deposition 28–42 minutes for deposits 0·0005–0·00075 in. thick with 20 amp./ft.^{2}; thin nickel sheet anodes in a steel tank lined with glass. Under these conditions smooth matt deposits may be obtained in thicknesses up to 0·1 in. Methods of controlling the composition of the bath are given; bivalent tin is determined by acidifying with hydrochloric acid and titration with iodine, quadrivalent tin by repeating this procedure but reducing with iron or nickel prior to titration, and free sodium hydroxide by titration with standard acid (after addition of barium chloride to precipitate the tin as barium stannate) using thymolphthalein as indicator. Deposits of tin on steel from the recommended bath are usually non-porous at a thickness of 0·0005 in., but a minimum of 0·00075 in. should be used when an absolutely non-porous deposit is required.—A. R. P.

The Maintenance of Solutions for Plating Rolled Zinc and Zinc-Base Die-Castings. L. Wright (*J. Electrodepositors' Tech. Soc.*, 1934, **9**, 177–184).—Cleaning is best effected by cathodic treatment in a boiling solution containing trisodium phosphate 4·5, sodium metasilicate 1·5 oz./gall., followed by hot- and cold-water rinsings and etching in 1% hydrofluoric acid or 8% hydrochloric acid. For nickel plating the electrolyte should contain nickel sulphate crystals 12, sodium sulphate crystals 32, ammonium chloride 2, and boric acid 1·5 oz./gall., and be operated at p_H 5·8–6·2. Impurities may be removed from the bath by occasional treatment with nickel carbonate at 60° C. to bring the p_H to 6·6–6·8, sulphuric acid being added after filtration to bring the p_H back to 5·8. The causes and prevention of faulty deposits are briefly discussed.—A. R. P.

Quantitative Throwing Power. Proposed New Expression. S. Field (*J. Electrodepositors' Tech. Soc.*, 1934, **9**, 144–152; and *Met. Ind.* (*Lond.*), 1934, **44**, 614–617).—The following definition of throwing power is suggested: throwing power is given by the ratio $100\,(L - M)/(L + M - 2)$, where L is the ratio of the distances from the anode of the remote and near half-cathodes, respectively, and M is the ratio of the weights of metal deposited on the near and remote half-cathodes, respectively; the test is made in an insulated rectangular trough 10 cm. wide inside, filled to a depth of 10 cm. with the plating solution and containing two half-cathodes 60 cm. apart with an intermediately disposed anode of perforated gauze parallel to the cathodes, the exposed area of the electrodes being equal to the cross-sectional area of the solution. In expressing the results, temperature, current density, and L should be stated. Comparisons are made of the throwing power of various electrolytes computed by this method and by those of other investigators.
—A. R. P.

Some Further Principles of Electrochemistry Applied to Electrodeposition. IV.—Ostwald's Law of Dilution. Samuel Field (*Met. Ind.* (*Lond.*), 1934, **45**, 473–474).—The application of Ostwald's law of dilution to the behaviour of weak electrolytes and the failure of strong electrolytes to conform to it are explained. See *Met. Abs.*, this volume, pp. 431, 508.—J. H. W.

The Mechanism of Electrodeposition. L. B. Hunt (*Trans. Electrochem. Soc.*, 1934, **65**, 413–423; discussion, 423–427).—For abstract of the paper, see *Met. Abs.*, this volume, p. 248. In the discussion various theories of the way in which electrodeposits of metals are built up were commented upon. —A. R. P.

The Plating of Castings. B. Caplan (*J. Electrodepositors' Tech. Soc.*, 1934, **9**, 93–96; and (abstract) *Met. Ind.* (*Lond.*), 1934, **44**, 327–328).—The cost of polishing and plating castings is often excessive. The method of preparing and plating ferrous and non-ferrous castings is described.—S. W.

The Manufacture of Castings for the Electroplating Industry. G. C. Pierce (*J. Electrodepositors' Tech. Soc.*, 1934, **9**, 97–100; and (abstract) *Met. Ind.* (*Lond.*), 1934, **44**, 377).—A very good quality casting is required for electroplating, for which purchasers should be prepared to pay a fair price. Skin porosity can be avoided by careful mould dressing and accurate temperature control. The lead content of brass castings is often excessive.—S. W.

***The Adherent Quality of Electrolytic Deposits—A Micrographic Study.** Michel Cymboliste (*Bull. Soc. Franç. Elect.*, 1934, [v], **4**, 1137–1166).—The nature and necessary conditions of adherent quality are defined. Breaking tests carried out on nickel-plating on steel and cast iron are described, and types of separation are classified, with many illustrations. Bad adhesion is attributed to imperfect cleaning of base, electrolysis of or other chemical attack of base, or too poor mechanical properties of the deposit, caused by wrong current density, temperature control, or composition of bath. The examination of surfaces actually in contact in unbroken samples confirms the foregoing conclusions, and the causes of failure depending on surface conditions are more fully discussed and enumerated. The value of micro-examination in locating and identifying sources both of weakness and of satisfactory quality is emphasized. —P. M. C. R.

Methods of Study of Control of Electrolytic Deposits. P. Jacquet (*Galvano*, **1934**, (27), 18–23; (28), 20–28).—Cf. *Met. Abs.*, this volume, p. 389. Report of a conference at the Institut de Chimie de Paris. Examination by the contractometer, by X-rays, and by metallography is discussed. Methods of determining adhesion, thickness, porosity, and mechanical properties of the electrodeposit are described.—E. S. H.

Testing of Plated Metals for Compliance with [American] Federal Specifications. M. R. Thompson (*Monthly Rev. Amer. Electroplaters' Soc.*, 1934, **21**, (2), 11–23; discussion, 23–28).—Results obtained on nickel, chromium, and zinc-plated articles purchased at random are compared with the demands of Federal specifications. In many types of work the deposits failed by a long way to comply with the specification. The discussion deals with methods to be adopted to encourage manufacturers to improve their products.—A. R. P.

Discussion on the Testing of Metallic Deposits. D. J. Macnaughtan. Dudley Weill. A. W. Hothersall. L. B. Hunt. G. E. Gardam. S. Wernick. H. R. Evans (*Met. Ind.* (*Lond.*), 1933, **42**, 307–309, 358–359).—Discussion on a paper by C. W. Borgman (see *J. Inst. Metals*, 1933, **53**, 196) read before the Electrodepositors' Technical Society, and B.'s reply.—J. H. W.

Rubber in the Plating Industry. R. H. Kittner (*Monthly Rev. Amer. Electroplaters' Soc.*, 1934, **21**, (3), 17–24; discussion, 24–25).—The manufacture of hard and soft rubber-lined tanks for plating and rinsing vats and for acid storage tanks is briefly described, and their advantages are outlined. —A. R. P.

Acid Cleaning and Plating with Rubber-Lined Equipment. H. E. Fritz (*Metal Cleaning and Finishing*, 1934, **6**, 159–164; *C. Abs.*, 1934, **28**, 3987).—The recently developed "anode" rubber-coating process and the use of rubber-lined and brick-sheathed equipment in pickling and plating plants are described.—S. G.

Electricity and the Electroplater. J. W. Perring (*J. Electrodepositors' Tech. Soc.*, 1934, **9**, 197–208).—An elementary explanation of the underlying principles of the economic application of electric power to electroplating and polishing processes.—A. R. P.

Economic Use of Water in Electroplating. L. C. Pan (*Metal Cleaning and Finishing*, 1934, **6**, 183–185; *C. Abs.*, 1934, **28**, 3986).—The advantages of the "counter-current" flow principle of rinsing are discussed.—S. G.

Some Further Principles of Electrochemistry Applied in Electrodeposition. III.—Anode Reactions. Samuel Field (*Met. Ind.* (*Lond.*), 1934, **45**, 325–326).—Cf. *Met. Abs.*, this volume, pp. 431, 508. The reactions taking place at the anode, the use of soluble and insoluble anodes, and the phenomenon of anode passivity are considered.—J. H. W.

Paths of Past and Future Progress in Electrodeposition. R. S. Hutton (*J. Electrodepositors' Tech. Soc.*, 1934, **9**, 137–143; and *Met. Ind.* (*Lond.*), 1934, **44**, 469–471).—A lecture reviewing the history of plating and indicating paths of future progress.—A. R. P.

VII.—ELECTROMETALLURGY AND ELECTROCHEMISTRY

(Other than Electrodeposition.)

(Continued from pp. 508–509.)

***On the Electrolytic Production of Alloys of Aluminium with Silicon.** K. P. Batashev and A. I. Zhurin (*Metallurg* (*Metallurgist*), **1933**, (2), 66–77).—[In Russian.] The binary system cryolite–silicon and the ternary system cryolite–silicon–aluminium have been investigated. By addition to the electrolytic aluminium bath, of a known amount of silicon, it is possible to obtain alloys of any desired composition with only small deviations in silicon content. The current yield based on the aluminium content varies between 70 and 85%. The alloys obtained, when remelted under ordinary conditions, display a modified structure.—N. A.

Electrocrystallization of Metals.—II. V. A. Kistiakovski and P. D. Dankov (*Izvestia Akademii Nauk S.S.S.R.* (*Bull. acad. sci. U.R.S.S.*), **1932**, [vii], 993–996; *Brit. Chem. Abs.*, **1933**, [A], 468).—[In Russian.] Preliminary addition of colloidal copper does not modify the structure of the copper precipitates obtained by electrolytic precipitation. Hence electrocrystallization of copper does not proceed with immediate formation of colloidal particles of the same type as those of ordinary colloidal copper.—S. G.

***The Rate of Displacement of Copper from Solutions of Its Sulphate by Cadmium and Zinc.** Cecil V. King and Martin M. Burger (*Trans. Electrochem. Soc.*, 1934, **65**, 403–410; discussion, 410–411).—For abstract of the paper, see *Met. Abs.*, this volume, p. 248. The discussion was concerned chiefly with a criticism of the methods adopted and of some of the conclusions drawn.—A. R. P.

†**Experiments to Find a Substitute for Platinum as an Anode Material in the Electrolytic Oxidation Process. I.—Tests with Tungsten Anodes.** Gosta Angel (*Z. Elektrochem.*, 1934, **40**, 641–647).—With a view to finding a substitute for platinum as an electrode in electrolytic oxidation, the behaviour of tungsten in the electrolysis of concentrated sodium chlorate solutions, with and without the addition of sodium chromate was studied experimentally. It was found, in agreement with other investigators, that tungsten exerted a marked regulating effect, while a compact oxide layer was formed on the metal. An appreciable current first passed with a cell voltage of 70. The tungsten anode was strongly attacked by the tungstic acid that was formed, the amount going into solution varying according to the applied voltage and the prehistory of

the anode. Tests with molybdenum anodes gave similar results. The statements that tungsten and molybdenum behave as practically insoluble anodes when soluble compounds with the metal oxides are not formed are therefore incorrect. Experiments on the anodic behaviour of tungsten in the presence of platinum in contact with it showed that the greater part of the current was carried to the electrolyte by the platinum, even when its anode surface was but a small fraction of that of the tungsten. In this case, the tungsten anode remained clean or coloured in spots. (See following abstract.) —J. H. W.

†**Experiments to Find a Substitute for Platinum as an Anode Material in the Electrolytic Oxidation Process. II.—Tests with Lead Peroxide Anodes.** Gösta Angel and Hjalmar Mellquist (*Z. Elektrochem.*, 1934, **40**, 702–707).—Electrodes were prepared by the anodic deposition of lead peroxide from an alkaline lead tartrate solution on starting sheets of iron, steel, or copper or on galvanically gilded sheets of these metals. A black, shining, very hard and compact deposit was obtained with a composition very close to the formula $PbO_2 \cdot H_2O$. It was found that a perchlorate formation on such an anode was possible, the current efficiency on the perchlorate increasing with increasing anodic current density. The highest efficiency, 79·2%, was obtained with a chromate-free solution with a current density of 20 amp./dm.^{2} at a temperature of 15° C. No corrosion of the peroxide layer and no cracks were observed. In some cases, the film was torn at a single point, which was traced to the presence of an impurity on the starting sheet. A very unusual temporary alteration of the cell voltage was observed, caused by a considerable alteration in the resistance of the anodes. A decrease in the resistance of the anodes occurred when they were first introduced which resulted in a fall in the voltage of 0·5–1·0 v., otherwise a slow increase in the resistance of the lead peroxide electrodes occurs. It was found that the increase in resistance was somewhat checked with gilded starting sheets. (See preceding abstract.)—J. H. W.

†**On the Application of the Law of Chemical Kinetics to Secondary Processes of Electrolysis.** S. A. Pletenew and W. N. Rosow (*Z. Elektrochem.*, 1934, **40,** 600–604).—It has been experimentally established that the solution of copper in a solution of ferric sulphate or cupric chloride, like the process of anodic oxidation with ferric sulphate, can be represented by the basic equation of chemical kinetics. As a result of the lowering of the rate of solution of copper in ferric sulphate solutions in the presence of aluminium salts, the viscosity of the solution increases. A series of electro-chemical processes in copper electrolysis can be calculated by the application of the basic chemical kinetics equation.—J. H. W.

***The Theory of Passivity Phenomena. XXIV.—On the Film Theory of Passivity and Chemical Passivity in Anodic Treatment of Iron in Sulphuric Acid.** W. J. Müller and E. Löw (*Z. Elektrochem.*, 1934, **40**, 570–578).—Continues the exposition of M.'s theory of passivity, with special reference to the passivity of iron in sulphuric acid. (See following abstract.)—J. H. W.

***The Theory of Passivity Phenomena. XXV.—Chemical Passivity and Its Electron Theory Significance.** Wolf Johannes Müller (*Z. Elektrochem.*, 1934, **40**, 578–582).—See preceding abstract. Continues the exposition of M.'s theory of passivity, and explains the difference between film passivity and chemical passivity. In the former case, the metal becomes passive with the normal valence in solution, while in the latter the electrode reaction changes towards greater solution or hydrogen evolution.—J. H. W.

***The Mechanism of Overvoltage and Its Relation to the Combination of Hydrogen Atoms at Metal Electrodes.** J. A. V. Butler (*Trans. Faraday Soc.*, 1932, **28**, 379–382).—The overvoltage of a platinum cathode is linearly proportional to the current density between 10^{-5} and 10^{-7} amp./cm.^{2}. That the slow decrease of hydrogen overpotential on a mercury cathode in dilute sulphuric acid is not due to the presence of alkali metals in the mercury is shown by the fact that it still appears with mercury which has been subjected to a drastic purification process.—A. R. P.

***The Relation Between Oxygen Overvoltage and Catalysis.** Allen D. Garrison and Johnny Fay Lilly (*Trans. Electrochem. Soc.*, 1934, **65**, 275–288; discussion, 288–289).—For abstract of the paper, see *Met. Abs.*, this volume, p. 249.—S. G.

The Measurement of p_H Value and Its Applications. J. Vassillière-Arlhac (*Bull. Soc. Franç. Élect.*, 1934, [v], **4**, 1081–1112).—The investigations of Pasteur, Ostwald, Sorensen, Fernbach and Hubert, and Noyes and Ellis are summarized, and the theoretical basis of p_H determinations is discussed, with the modification involved by the " buffer " effect. Metallurgical and other applications of exact p_H determination are enumerated.—P. M. C. R.

Economic Importance of the Electrochemical Industries. C. L. Mantell (*Trans. Electrochem. Soc.*, 1932, **62**, 15–25; and (summary) *Met. Ind.* (*Lond.*), 1932, **41**, 547–548).—Deals with the financial aspects of the electrochemical industries such as price–power cost relations for electrochemical products, power costs at electrochemical centres, and refinery capacity and power installation for electrolytic copper and zinc. These are given in tables.—I. M.

VIII.—REFINING

(Continued from p. 355.)

The Production and Refining of Antimonial Lead, Antifriction, and Printers' Alloys. G. J. Brittingham (*Chem. Eng. Min. Rev.*, 1934, **26**, 415–418).—The production and refining of antimonial lead from antimonial slag obtained in lead smelting is described. This lead is used for the production of printers' metal and antifriction metal. Lead and antimonial lead are melted at 220°–300° C., and poled with a green stick for 4–5 hrs. The dross is removed, and premelted antimony and finally block tin are added. A small sample is taken and rapidly assayed. If it is correct, the metal is poured, and a test-bar is taken for a fracture test. If this is unsatisfactory, the entire round is remelted. In the case of antifriction metal, the copper or copper and metal are premelted with the antimony.—J. H. W.

On the Refining of Scrap Nickel. Herbert Hermann (*Chem.-Zeit.*, 1934, **58**, 481–482).—The chief difficulties in producing sound metal from scrap are due to the high affinity of nickel for oxygen, carbon monoxide, and sulphur. Addition of magnesium to the molten metal effectively removes sulphur and oxygen, about 0·12–0·15% of magnesium usually being sufficient; manganese can be used when sulphur is absent. In reverberatory melting of nickel scrap the furnace should be basic-lined, since nickel oxide rapidly destroys silicious refractories; the fuel used, whether gas or oil, should have a high calorific value and a very low sulphur content. In crucible melting the metal should be heated to 1550° C. and well stirred to oxidize impurities; if lead is present the temperature should be maintained for 3–4 times the usual period and preferably a little zinc added, since this assists in the oxidation and volatilization of lead. The refined metal is eventually deoxidized, first with manganese, then with magnesium, the process being followed by fracturing small test-bars, cast from time to time.—A. R. P.

Recovery of Scrap Tin and Electrolytic Refining of Tin. W. A. Vanyukov and N. N. Muratch (*Zvetnye Metally* (*The Non-Ferrous Metals*), **1932,** 29–41; *Chem. Zentr.*, 1932, **103**, II, 2232).—[In Russian.]—S. G.

IX.—ANALYSIS

(Continued from pp. 509–512.)

Magneto-Optical Method of Chemical Analysis. J. W. Buchta (*Physics*, 1932, **3**, 54–56).—S. G.

***Use of Benzidine Complexes in Quantitative Analysis [of Metals].** J. Barceló (*Anales soc. españ. fis. quím.*, 1934, **32**, 91–104).—Cu can be determined gravimetrically by addition of benzidine (Bzd) to $CuCl_2$ whereby $[CuBzd]Cl_2$ is quantitatively precipitated; sulphates, acetates, and nitrates must be absent. Cd and Zn can be precipitated as $[Cd(or\ Zn)Bzd]SO_4$, but Ag and Hg, although quantitatively precipitated by Bzd from HNO_3 and HCl solutions respectively, cannot be determined satisfactorily in this way. Hg can be separated from Cu in CH_3CO_2H solution by precipitation with Bzd. —A. R. P.

***Analysis of Light Aluminium Alloys.** J. J. Lurie (*Zavod. Lab.*, 1934, **3**, 222–226; *Brit. Chem. Abs.*, **1934**, [B], 678).—[In Russian.] 1 grm. of alloy is dissolved in 25 c.c. of 20% H_2SO_4, 10–15 c.c. of H_2S–H_2O are added, the solution is filtered, the filtrate is boiled to remove H_2S, Fe^{II} is oxidized by adding a few drops of H_2O_2 and 2–3 grm. of tartaric acid, and a few drops of concentrated aqueous KCNS are added to the cooled solution. Concentrated aqueous NaOAc is then added until the colour changes from red to yellow, when 20 c.c. of a saturation of 2·7 grm. of $HgCl_2$ and 3·9 grm. of KCNS in 100 c.c. of H_2O are added, and the precipitate of $ZnHg(CNS)_4$ is collected after 1 hr. The Zn content may be calculated from the weight of $ZnHg(CNS)_4$, or it may be derived volumetrically as follows: the precipitate of $ZnHg(CNS)_4$ is shaken with 5 c.c. of $CHCl_3$, 5 c.c. of H_2SO_4, and 20 c.c. of concentrated HCl, and the mixture is titrated with standard aqueous KIO_3 until the $CHCl_3$, which at first becomes violet, is decolorized, according to the reactions $5ZnHg(CNS)_4 + 24KIO_3 + 8H_2O + 4HCl = 5ZnSO_4 + 5HgSO_4 + 10K_2SO_4 + 24I + 4KCl + 20KCN$, and $4I + KIO_3 + 6HCl = 5ICl + 3H_2O + KCl$. Zn may be determined more rapidly, but less accurately, by electrodeposition from aqueous Na_2ZnO_2.—S. G.

***Analysis of Magnesium Alloys.** L. C. Nickolls (*Analyst*, 1934, **59**, 16–18). —The alloy is dissolved in dilute HCl, the solution evaporated to dryness, the residue dissolved in very dilute HCl and the SiO_2 filtered off; the filtrate is treated with H_2S and the precipitate used for the determination of Cu, &c., in the ordinary way. The filtrate from the Cu is treated with NH_4OH until it becomes dark green with FeS, $6N$-Na_2S solution is added, and H_2S passed to precipitate $FeS + Al(OH)_3$. After 1 hr. on the water-bath the precipitate is collected, washed, and redissolved in HCl; the solution is oxidized with Br and the $Fe(OH)_3$ and $Al(OH_3)$ precipitated with NH_4OH, washed, ignited, and weighed as oxides, Fe being subsequently determined by titration with $Ti_2(SO_4)_3$ of the solution obtained by fusing the oxides with $KHSO_4$ and leaching with dilute H_2SO_4. Al is determined by difference. The Na_2S filtrate is used for the determination of Ca and the NH_4OH filtrate for the determination of Ni and Zn.—A. R. P.

Analysis of Zinc Alloys. A. Milovidova and Z. Glazunova (*Zavod. Lab.*, 1934, **3**, 369; *Brit. Chem. Abs.*, **1934**, [B], 677).—[In Russian.] 1 grm. of alloy is treated with hot dilute H_2SO_4, when Pb and Cu remain undissolved; these are dissolved in 50% HNO_3, and determined electrolytically. Al and Fe are precipitated from the H_2SO_4 solution by adding excess of aqueous NH_3 and NH_4Cl, and Zn is determined electrolytically in the filtrate. The residual solution is evaporated to a small volume, when a further precipitate of $Al(OH)_3$ forms, which is added to that obtained previously. Mg is determined by the usual methods in the filtrate.—S. G.

***Potassium Permanganate as a Microchemical Reagent for Some Metals.** N. S. Poluektov and W. A. Nasarenko (*Pharm. Zentralhalle*, 1934, **75**, 424–426; *Chem. Zentr.*, 1934, **105**, II, 1810).—With $KMnO_4$ solution and NH_4OH Ni solutions give dark violet, almost black cubes and rectangles, Zn black tetrahedra, and Cd black tetrahedra more soluble than the Zn compound. With $KMnO_4$ and C_5H_5N Cu gives pale violet long six-sided plates, Ag dark violet needles, Ni violet spheres, and Cd violet plates. Ag salts give violet six-sided stars with $KMnO_4$ and $(CH_2)_6N_4$.—A. R. P.

Detection of Aluminium by Fractional Precipitation. Ch. N. Potschinok (*Zhurnal Prikladnoi Khimii* (*J. Applied Chem.*), 1933, **6**, 948–950; *Chem. Zentr.*, 1934, **105**, I, 3089).—[In Russian, with German summary.] Small quantities of Al may be detected in the presence of much Cu, Co, Ni, Hg, and Pb by treating the feebly acid chloride solution with $(NH_4)_2S$, removing the sulphide precipitate, and boiling the filtrate with $Na_2S_2O_3$ and alizarin. As little as 0·04 mg. of Al gives the characteristic red precipitate.—A. R. P.

***On a Qualitative Reaction for Radium.** B. A. Nikitin (*Dokladi Akademii Nauk S.S.S.R.* (*Compt. rend. Acad. Sci. U.R.S.S.*), **1934**, [N.S.], (1), 19–21).—[In Russian and German.] On treating a boiling solution of 0·01 grm. of radium as chloride (containing less than 1% Ba) in 10 c.c. H_2O with 0·3 c.c. of 50% CCl_3COOH and 0·5 c.c. of 10% K_2CrO_4 the hot solution becomes slightly opaque and deposits a dense, crystalline precipitate on cooling to 0° C. A 0·1% solution of Ba gives no such precipitate. The reaction is purely qualitative, since some Ra remains in the filtrate. The test is applicable only to solutions containing 0·02–1% Ra.—N. A.

***Detection of Rhenium in Noyes' and Bray's System of Qualitative Analysis.** Chung-Hsi Kao and Tsing-Lien Chang (*J. Chinese Chem. Soc.*, 1934, **2**, 6–12; *C. Abs.*, 1934, **28**, 3686).—[In English.] Additional procedures are described to provide for the detection and confirmation of Re. The filtrate from the Ir–Rh precipitate is treated with HCl, $H_2N_4 \cdot HCl$, and $NaHSO_3$ and filtered, and the Re is precipitated by H_2S. The Re is confirmed by dissolving in H_2O_2, adding $KMnO_4$ and a drop of RbCl, and identifying the crystals under the microscope.—S. G.

***Sensitive Reaction for Thallium by the Spot Method.** N. S. Poluektov (*Redkie Metalli* (*Rare Metals*), **1933**, (4) 41–42).—[In Russian.] A drop of saturated phosphomolybdic acid solution is placed on a filter paper and the centre of the spot is touched with a drop of the solution to be tested. Another drop of the acid is added and, if Cu is present, the spot is washed with two drops of saturated $(NH_4)_2C_2O_4$ solution. If a capillary dipped in 50% HBr is then drawn across the damp spot the centre is coloured bluish-green if Tl is present. When only Cu is present the centre remains colourless, whilst the edges of the streak made by the HBr are coloured violet. The reaction cannot be used in the presence of $Sn^{\cdot\cdot}$, $Sb^{\cdot\cdot\cdot}$, $Fe^{\cdot\cdot}$, and the Cu content must not exceed 300 times the Tl content. The sensitivity is 0·2 γ Tl per drop.—D. N. S.

***Two New Sensitive Reactions of Vanadium.** A. S. Komarowsky and N. S. Poluektov (*Redkie Metalli* (*Rare Metals*), **1933**, (4), 43–45).—[In Russian.] (1) A drop of the neutral or faintly acid solution is heated for 1 minute in a porcelain dish on the water-bath with 5% $H_2C_2O_4$ solution to reduce V^V to V^{IV}. On cooling, a drop of phosphomolybdic acid and a drop of 25% NaOH are added; if V is present a blue colour develops (sensitivity 9·48 γ V). The reaction is retarded by $Ce^{\cdot\cdot\cdot}$, $Pd^{\cdot\cdot}$, $Co^{\cdot\cdot}$, $Sn^{\cdot\cdot}$, $Sb^{\cdot\cdot\cdot}$, whilst $Fe^{\cdot\cdot\cdot}$ and H_2CrO_4 must be removed previously. (2) A drop of the solution mixed in a porcelain dish with a few crystals of Na tartrate to remove the effect of Mo and W is heated to boiling and a drop of 8-hydroxyquinoline in CH_3COOH solution is added; in the presence of V, a black precipitate or turbidity appears (sensitivity is 9·27 γ V). $Fe^{\cdot\cdot\cdot}$ must first be removed with NaOH.—D. N. S.

Quantitative Separation of Metals by Hydrogen Sulphide. II.—Quantitative Separation of Cobalt from Zinc by Hydrogen Sulphide. Hisaji Katō (*Nippon Kwagaku Kwai-shi* (*J. Chem. Soc. Japan*), 1934, **55**, 213–220; *C. Abs.*, 1934, **28**, 3683).—[In Japanese.] The statements of Haring and Leatherman (*J. Amer. Chem. Soc.*, 1930, **52**, 5135–5141) are questioned. CoS can be precipitated completely if the initial $p_H > 2{\cdot}7$ and the final $p_H > 1{\cdot}3$. To precipitate ZnS in the presence of Co^{++} buffer the faintly acid solution with plenty of $CH_2ClCOOH$ and its Na salt to $p_H = 2{\cdot}2$ and saturate with H_2S for 30 minutes.—S. G.

*__On the Analytical Separation of Iridium and Rhodium.__ B. G. Karpov and A. N. Fedorova (*Izvestia Platinogo Instituta* (*Ann. Inst. Platine*), 1933, (11), 135–139).—[In Russian.] The mixed chloride solution (600–800 c.c.) is treated with 40 c.c. of conc. HCl, 3–5 c.c. of a saturated solution of $HgCl_2$, and an excess of VCl_2 solution. After 2 hrs., the precipitate is collected in a porous porcelain crucible, washed with hot very dilute HCl, and redissolved in *aqua regia*. The precipitation is repeated 2–3 times, the $HgCl_2$ not being added the last time. The ignited Rh precipitate, before weighing, is treated with HCl and HF, and reduced with H_2. Satisfactory separations of 0·001–0·0106 grm. of Rh from 0·4–4·0 grm. of Ir were obtained.—N. A.

*__Separation of Iron from Thorium.__ N. I. Matveev (*Zhurnal Prikladnoi Khimii* (*J. Applied Chem.*), 1931, **4**, 275–282; *C. Abs.*, 1932, **26**, 393).—[In Russian.] The Fe^{+++} is precipitated by $(NH_4)_2S$ in ammoniacal tartrate solution, and the Th is precipitated in the filtrate by cupferron in the usual way, from a buffered solution of AcOH.—S. G.

*__On the Electrolytic Deposition of Metallic Niobium and Its Separation from Tantalum.__ N. A. Isgarischev and A. F. Prede (*Redkie Metalli* (*Rare Metals*), **1933**, (2), 41–47).—[In Russian.] From a solution of 1·128 grm. Ta_2O_5 and 0·872 grm. Nb_2O_5 in 150 c.c. of 40% KOH containing 3% dextrin, a bright, firm deposit of pure Nb was obtained, at a current efficiency of 0·06% with 0·25 amp./cm.^{2} at 4 v. at 100° C. A poorer plate was obtained by fusing 0·564 grm. Ta_2O_5 and 0·436 grm. Nb_2O_5 with $K_2S_2O_7$, dissolving the melt in 75 c.c. of saturated $(NH_4)_2C_2O_4$ and 5 c.c. of saturated $H_2C_2O_4$ solution and electrolyzing with 0·15 amp./cm.^{2}, at 3–4 v., at 75°–80° C. From a similar solution in 100 c.c. of 60% citric acid at 0·15 amp./cm.^{2}, and at above 80° C. a good Nb plate was obtained; the method is applicable to the electro-analysis of Nb.—D. N. S.

*__On the Analytical Chemistry of Tantalum and Niobium.__ Victor Schwarz (*Angew. Chem.*, 1934, **47**, 228–230).—The separation of Ta from Nb by means of tannin in $(NH_4)_2C_2O_4$ solutions is facilitated by the presence of 8 c.c. of 5% sulphosalicylic acid for every 0·05 grm. of mixed oxides, since a more gradual neutralization with NH_4OH can then be obtained and the end of the Ta precipitation is thus more easily recognized. In H_2SO_4 solution Ti, Nb, and Ta can be separated from W, Mo, and V^V by precipitation with H_2SeO_3, since the latter group of elements yields yellow solutions containing soluble complexes; $H_2C_2O_4$, H_2O_2, and HCl retard precipitation of the Ti, Nb, and Ta. Ce, Th, and Zr can be separated from Nb, Ta, and Ti by cautious addition of NH_4OH to a H_2SO_4 solution of the metals containing H_2O_2.—A. R. P.

*__Determination of Metals by Means of the Oxine, Chloro-Oxine, and Bromo-Oxine Methods.__ Saburo Ishimaru (*Nippon Kwagaku Kwai-shi* (*J. Chem. Soc. Japan*), 1934, **55**, 201–212; and *Kinzoku no Kenkyu*, 1934, **11**, 448–460; *C. Abs.*, 1934, **28**, 3681).—[In Japanese.] In the gravimetric determination of W, V, and Mo by the oxine method and of Ti, Fe, and Cu by the chloro-oxine or bromo-oxine method, the proper drying temperature was measured by the thermobalance. The determination of Ti as $TiO(C_9H_4Br_2ON)_2$ by drying cannot be recommended, as the suitable temperature range is very small. Anhydrous $H_2C_2O_4$ was mixed with each complex salt, then the

Method.	Element.	Formula of Salt.	Proper Drying Temperature, ° C.
Oxine	W	$WO_2(C_9H_6ON)_2$	95–128
,,	V	$V_2O_3(C_9H_6ON)_4$	120–154
,,	Mo	$MoO_2(C_9H_6ON)_2$	135–159
Chloro-oxine	Ti	$TiO(C_9H_4Cl_2ON)_2$	142–169
,,	Fe	$Fe(C_9H_4Cl_2ON)_3$	112–198
,,	Cu	$Cu(C_9H_4Cl_2ON)_2$	122–192
Bromo-oxine	Ti	$TiO(C_9H_4Br_2ON)_2$	116–117
,,	Fe	$Fe(C_9H_4Br_2ON)_3$	118–140
,,	Cu	$Cu(C_9H_4Br_2ON)_2$	127–177

Method.	Element.	Oxide.	Proper Ignition Temperature, ° C.
Oxine	W	WO_3	>420
,,	V	V_2O_5	>468
,,	Mo	MoO_3	505–548
Chloro-oxine	Ti	TiO_2	>443
,,	Fe	Fe_2O_3	>478
,,	Cu	CuO	>525
Bromo-oxine	Ti	TiO_2	>400
,,	Fe	Fe_2O_3	>458
,,	Cu	CuO	>525

mixture was heated, and the element was determined as oxide. The proper ignition temperature for this procedure was also determined by thermobalance.—S. G.

***Studies on Gravimetric Analysis by Means of the Thermobalance. XIX.—Determination of Metals by Means of Anthranilic Acid.** Saburo Ishimaru (*Nippon Kwagaku Kwai-shi* (*J. Chem. Soc. Japan*), 1934, **55**, 288–292; *C. Abs.*, 1934, **28**, 4331).—[In Japanese.] By means of the thermobalance proper drying temperatures were determined for anthranilates as follows: Zn 105°–141°, Cd 105°–152°, Co 107°–202°, Ni 105°–162°, Cu 106°–187° C. Proper ignition temperatures to obtain oxides by fusion of the anthranilates with anhydrous $H_2C_2O_4$ were determined as: Zn over 645°, Cd over 453°, Co over 1005°, Ni over 830°, Cu over 473° C.—S. G.

***On the Estimation of Gas in Aluminium by the Hot-Extraction Process.** K. Steinhäuser (*Light Metals Research*, 1934, **3**, 65–76).—Translated from *Z. Metallkunde*, 1934, **26**, 136–139. See *Met. Abs.*, this volume, p. 510. —J. C. C.

The Prospects of the Development of Spectrographic Analysis in the Light Metal Industry. J. A. Kliachko (*Legkie Metally* (*Light Metals*), **1934**, (4), 22–28).—[In Russian.] The advantages and disadvantages of spectrographic analysis in comparison with chemical analysis for light metals and alloys are discussed.—D. N. S.

Determination of Aluminium in Aluminium and Its Alloys. J. J. Lurie (*Zavod. Lab.*, 1934, **3**, 495–498; *Brit. Chem. Abs.*, **1934**, [B], 890).—[In Russian.] 0·5 grm. of Al is dissolved in 35 ml. of 20% HCl, the filtrate is evaporated to dryness, the residue dissolved in 50 ml. of 10% HCl, the solution made neutral with aqueous NH_3, 4 ml. of 10% H_2SO_4 are added, and cations other than Ti, Zr, V, U, Be, Al, and Mg are removed by electrolysis, using a Hg cathode. Of these only Al and Mg are usually present, and Al is quantitatively precipitated by Ardagh and Bongard's procedure (*Indust. and Eng. Chem.*, 1924, **16**, 297–299) as $Al(OH)_3$, which is ignited and weighed as Al_2O_3. The experimental error is $\not>$ 0·1%.—S. G.

***Studies on Gravimetric Analysis by Means of the Thermobalance. XX.—Determination of Antimony and the Elements of the Platinum Group.** Hidehiro Goto (*Nippon Kwagaku Kwai-shi* (*J. Chem. Soc. Japan*), 1934, **55**, 326–330; *C. Abs.*, 1934, **28**, 4331).—[In Japanese.] By means of the thermobalance the proper ignition or drying temperatures were determined for compounds of Sb, Pt, Os, Ru, Ir, and Rh. For Sb determined as Sb_2O_4 the proper ignition temperature is 700°–950° C.; as Sb_2O_5 over 800° C.; as $NaSbO_3$ 450°–700° C.; as metallic Sb 100°–250° C. For Pt determined as the metal by ignition as PtS the temperature should be above 650° C.; determined by reduction to Pt by Hg_2Cl_2 above 550° C.; determined by reduction to Pt by formic acid above 100° C.; determined as Tl_2PtCl_6 less than 250° C.; determined as metallic Pt by ignition of Tl_2PtCl_6 above 700° C. For determination of Os as OsS_4 the temperature should be less than 190° C.; for Ru as RuO_2 above 850° C.; for Ru, Ir, and Rh as the metals less than 500° C. It is not necessary to heat the metallic Ru, Ir, and Rh when the temperature is lower than 500° C. The heating can take place in the air.—S. G.

***Investigations on the Electrolytic Determination of Antimony, Copper, and Tin in Their Alloys.** A. J. Lindsey and H. J. S. Sand (*Analyst*, 1934, **59**, 335–338).—The alloy (0·3 grm.) is dissolved in HCl (10 c.c.) and 10% NH_4Cl solution (10 c.c.) with the aid of a little $KClO_3$; a further 5 c.c. of HCl are added, followed by 1 grm. of $NH_2OH{\cdot}HCl$, and the solution is diluted to 100 c.c. and electrolyzed by the internal electrolysis method using an auxiliary electrode at less than 0·4 v. at 65°–75° C. The weighed Cu + Sb deposit is dissolved in HNO_3 and HF, the solution diluted to 100 c.c., and the metals separated by Lassieur's method. Sn is recovered from the first electrolyte by addition of 1 grm. of $NH_2OH{\cdot}HCl$ and electrolysis for 15–20 minutes at 1–1·5 amp.
—A. R. P.

***The Determination of Bismuth with the Aid of Alkali Thiocyanates.** Eero Tommila (*Suomen Kemistilehti*, 1934, **7**, B79; *Chem. Zentr.*, 1934, **105**, II, 643).—[In German.] Sulphate solutions of Bi give a yellow colour with a large excess of KCNS. The sensitivity of a spot test is 1 γ Bi in a concentration of 1 : 50,000. Mo interferes but can be removed by shaking the solution with ether.—A. R. P.

***On the Colorimetric Determination of Small Quantities of Copper in the Presence of Iron.** A. Castiglioni (*Z. anal. Chem.*, 1934, **97**, 270–273).—The chloride solution is boiled for 5 minutes with 0·5 grm. of $Na_2S_2O_4$ and the Cu precipitate collected, washed, and dissolved in HNO_3. The solution is treated with an excess of NH_4OH and with 1 c.c. of $(NH_4)_2S$; after dilution to 100 c.c. its absorption and extinction coeff. are determined in a colorimeter and the Cu content read from a curve.—A. R. P.

***Potentiometric Determinations in Alkaline Solutions. Determination of Copper and Silver.** C. del Fresno and E. Mairlot (*Anales soc. españ. fís. quím.*, 1934, **32**, 280–285).—In the titration of $Cu^{\cdot\cdot}$ with $VOSO_4$ in NH_4OH solutions potential jumps are observed when all the $Cu^{\cdot\cdot}$ is converted into $Cu^{\cdot}$ and again when the $Cu^{\cdot}$ is reduced to metallic Cu. Similarly $Ag^{\cdot}$ gives a marked potential jump when it is all reduced to metal, hence potentiometric titration of an ammoniacal Ag–Cu solution with $VOSO_4$ shows three well-defined potential jumps, the first being due to the Ag reaction.—A. R. P.

***On a Rapid Method for the Determination of Copper.** A. Tettamanzi (*Industria chimica*, 1934, **9**, 609–610; *Chem. Zentr.*, 1934, **105**, II, 1811).—The neutral Cu solution is treated in a 250 c.c. graduated flask with an excess of 15% C_5H_5N solution and then with a measured volume of 0·1*N*-KCNS to precipitate the Cu as $Cu(C_5N_5N)_2(CNS)_2$. After 30 minutes the solution is diluted to the mark and 200 c.c. are filtered through a dry paper and titrated with $AgNO_3$ after acidifying with HNO_3. Ni, Co, Mn, Zn, and Cd interfere. —A. R. P.

***Separation of Copper from Other Metals with Ammonium Oxalate and Its Gravimetric Determination.** Antonio Hemmeler (*Ann. chim. applicata*, 1934, **24**, 140–154; *Chem. Zentr.*, 1934, **105**, II, 1169).—The method is based on the solubility of CuC_2O_4 in solutions of $(NH_4)_2C_2O_4$ and its reprecipitation by addition of H_2SO_4 or HNO_3; ignition of the precipitate affords metallic Cu. The process gives good separations of Cu from many other metals provided that no halides are present in the solution.—A. R. P.

Volumetric Determination of Copper and Lead in Babbitt Metal. E. S. Gavrilenko and V. S. Kobzarenko (*Zhurnal Prikladnoi Khimii* (*J. Applied Chem.*), 1933, **6**, 945–947; *C. Abs.*, 1934, **28**, 4002).—[In Russian, with German summary.] Cf. *Met. Abs.*, this volume, p. 25. Treat the alloy with HNO_3 and filter off the residue of metastannic and metantimonic acid. The Pb is precipitated in the filtrate by treatment with a saturated solution of $(NH_4)_2C_2O_4$. To the filtrate add $(NH_4)_2C_2O_4$ and an excess of NH_4OH. Wash the precipitate with cold water and titrate the oxalate with $KMnO_4$ in the presence of acid. Concentrate the ammoniacal Cr solution to about 60 c.c. and titrate the Cu iodometrically.—S. G.

***Spectrographic Determination of Copper and Lead in Alloys [with an Appendix on the Rapid Analysis of Alloys by Volatilization of a Constituent].** Wolfgang Schuhknecht (*Thesis : Univ. Leipzig*, **1934**, 95 pp.).—Cu in concentrations from 0·0001 to 1·0% in Pb can be determined spectrographically by the logarithmic sector or wedge photometer methods using the homologous line-pair : λ Pb = 3671·5 A. and λ Cu = 3247·5 A. For the spectrographic analysis of 0·2–2·0% Pb in Cu several homologous line-pairs can be used, but for smaller quantities than 0·2% Pb comparison must be made directly with alloys of known Pb content; in the analysis of Pb-rich alloys there is uncertainty introduced by the tendency of the Pb to segregate to the grain boundaries. The Zn content of brass and the Pb content of Pb–Sn alloys can rapidly be determined by the loss in weight on heating the alloys at 1100° C. *in vacuo* for 5–6 minutes, whereby the Zn and Pb are completely volatilized. An apparatus and technique for this procedure is described by the use of which errors due to spray losses and volatilization of Cu or Sn are avoided. The procedure is not applicable to alloys containing Sb which is not completely volatilized under the prescribed conditions.—A. R. P.

***Application of Liquid Amalgams to Volumetric Analysis. XVIII.—Estimation of Iron, Titanium, Molybdenum, and Uranium by Means of Ceric Sulphate.** Ryōji Takeno (*Nippon Kwagaku Kwai-shi* (*J. Chem. Soc. Japan*), 1934, **55**, 196–198; *C. Abs.*, 1934, **28**, 3682).—[In Japanese.] Cf. Furman and Wallace, *J. Amer. Chem. Soc.*, 1930, **52**, 2347–2352. Fe and Ti were reduced by means of Zn amalgam and then oxidized with $Ce(SO_4)_2$. The oxidation proceeds quantitatively and can be used as a means of titration. Diphenylamine serves as indicator. To determine Mo and U, an excess of $Ce(SO_4)_2$ was added to the solutions and the excess was titrated back with ferrous sulphate, with methyl red as indicator.—S. G.

***Application of Liquid Amalgams to Volumetric Analysis. XIX.—Estimation of Calcium and Sodium.** Masatake Kasai (*Nippon Kwagaku Kwai-shi* (*J. Chem. Soc. Japan*), 1934, **55**, 242–243; *C. Abs.*, 1934, **28**, 3682).—[In Japanese.] Ca can be precipitated in ammoniacal solution as Ca molybdate and the Mo determined as previously described (preceding abstract). Na can be precipitated as uranyl zinc acetate and the U titrated by the above method.—S. G.

Determination of Small Quantities of Lead in Copper and Copper–Zinc Alloys Containing Manganese. M. I. Schubin (*Zavod. Lab.*, 1934, **3**, 396–401;

Brit. Chem. Abs., **1934**, [B], 840).—[In Russian.] Traces of Pb cannot be determined electrolytically in alloys containing manganese, which is deposited together with Pb at the anode; Mn should be eliminated previously by Gampe's procedure.—S. G.

***Gravimetric Analysis by Means of the Thermobalance. XVII.—Determination of Lithium, Rubidium, and Cæsium.** Ippei Kitajima (*Nippon Kwagaku Kwai-shi* (*J. Chem. Soc. Japan*), 1934, **55**, 199–200; *C. Abs.*, 1934, **28**, 3681).—[In Japanese.] By means of a thermobalance proper ignition temperatures for gravimetric analysis were determined.

Element.	Determined as	Proper Ignition Temperature, ° C.
Li	Li_2SO_4	>470
Li	Li_3PO_4	>400
Li	LiF	270–440
Rb	Rb_2SO_4	>490
Rb	RbCl	450–740
Rb	Rb_2PtCl_6	310–420
Cs	Cs_2SO_4	480–870
Cs	CsCl	530–640
Cs	Cs_2PtCl_6	340–440

—S. G.

Rapid Volumetric Determination of Magnesium in Duralumin. N. Zotova (*Zavod. Lab.*, 1934, **3**, 465; *Brit. Chem. Abs.*, **1934**, [B], 890).—[In Russian.] 2 grm. of Duralumin are dissolved in 40 c.c. of 25% KOH, the solution is diluted, and the precipitate of Cu, Fe, Mg, and Mn hydroxides is dissolved in 35 c.c. of concentrated HNO_3; 2 grm. of $KClO_3$ are added, and the solution is concentrated to 10 c.c., when Mn separates as MnO_2. The suspension is diluted to 60 c.c., 30 c.c. of 25% NH_4Cl are added, and aqueous NH_3 to the formation of a blue coloration due to Cu complexes. The solution is filtered, the filtrate containing only Cu and Mg is decolorized by excess of 10% KCN, and 7–8 c.c. of 25% hydroxyquinoline in EtOH are added at 60°. The precipitate of Mg salt of hydroxyquinoline is dissolved in warm 8% HCl, excess of $0{\cdot}1N$-KBr–$KBrO_3$ and 5 c.c. of 20% KI are added, and the I_2 liberated is titrated with $0{\cdot}1N$-$Na_2S_2O_3$.—S. G.

***A Rapid and Exact Method for the Determination of Magnesium by Fractional Precipitation.** N. A. Tananaeff and P. S. Sawtschenko (*Zhurnal Prikladnoi Khimii* (*J. Applied Chem.*), 1933, **6**, 970–975; *Chem. Zentr.*, 1934, **105**, I, 3240).—[In Russian, with German summary.] The method depends on the fact that all the interfering elements in the phosphate precipitation can be removed by treating the solution with a large excess of NH_4Cl, boiling, and adding a solution of Na_2CO_3 containing Na_2O_2 drop by drop until no further precipitation occurs. In the filtrate the Mg can be precipitated as $MgNH_4PO_4$ in the usual way, or as $Mg(OH)_2$ by addition of H·CHO to destroy the NH_4 salts followed by NaOH to alkalinity (phenolphthalein).—A. R. P.

***Alkalimetric Determination of Mercury as Amidochloride.** Stanislav Škramovský and Radim Uzel (*Časopis českoslov. Lékárnictva*, 1934, **14**, 33–45; *Chem. Zentr.*, 1934, **105**, II, 642).—The method depends on the precipitation of "infusible white precipitate" by addition of NH_4OH to the $HgCl_2$ solution, neutralization of the excess of NH_4OH with dilute acid, addition of $Na_2S_2O_3$ or KI to convert the Hg into a complex iodide or thiosulphate and acidimetric titration of the liberated NH_4OH.—A. R. P.

Detection and Determination of Nickel with Dimethylglyoxime in the Presence of Copper. José Ranedo (*Anales soc. españ. fís. quím.*, 1934, **32**, 611–613; _C. Abs._, 1934, **28**, 6388).—Directions are given for the detection and determination of Ni in alloys.—S. G.

*__Potentiometric Studies of the Quinhydrone Electrode in the Determination of Nickel.__ B. K. Chatterjea and J. B. Jha (_J. Indian Chem. Soc._, 1933, **10**, 727–733).—A sharp potential jump occurs in the titration of Ni salts with KCN when all the Ni is converted into $Ni(CN)_2$. The titration is carried out with a quinhydrone electrode in a solution of p_H 7–8 containing 0·1–0·34 grm. of Ni in 25 c.c. Titration of Ni salts with Na_2CO_3 gives erroneous results due to the formation of basic compounds.—A. R. P.

*__New Method for the Detection of Triethanolamine and for the Colorimetric Determination of Nickel and of Triethanolamine.__ E. Jaffe (_Industria chimica_, 1934, __9__, 151–153; _Chem. Zentr._, 1934, __105__, II, 642).—Ni solutions give a blue colour with triethanolamine which becomes yellowish-green on addition of KOH and pure emerald-green on the subsequent addition of NH_4OH.—A. R. P.

*__Researches on the Determination and Separation of Nickel and Zinc.__ Otto Lutz (_Thesis: Univ. Geneva_, __1930__, 21 pp.).—In the determination of Ni as dimethyl-(or phenyl-)glyoxime high results are obtained by weighing the dried precipitate when the Ni exceeds 0·1 grm. owing to the difficulty of removing excess of the precipitant. Calcination of the precipitate in a current of O_2 and weighing as NiO, or after subsequent reduction in H_2 as Ni, gives accurate results. Precipitation of Ni as pyridine or pyramidone thiocyanate and weighing of the precipitate also gives good results irrespective of the weight of Ni; these two methods can be satisfactorily used for the determination of Zn. For the separation of Ni from Zn precipitation with glyoxime is satisfactory, whereas precipitation with KOH gives low Zn results. Complete separation of Zn may be effected by saturating the chloride solution of the metals with Br, allowing it to fall drop by drop into 20% KOH solution, and boiling the mixture for 10 minutes; the Ni is precipitated as Ni_2O_3 and the Zn can subsequently be recovered as $ZnCO_3$. Precipitation of Zn by H_2S by the "salting-out" method is unsatisfactory in the presence of much Ni.
—A. R. P.

Determination of Phosphorus in Aluminium. W. D. Treadwell and J. Hartnagel (*Helv. Chim. Acta*, 1932, **15**, 1023–1029; and (abstract) *Chim. et Ind.*, 1933, **29**, 1334; *C. Abs.*, 1933, **27**, 41).—A microdetermination is described which serves to determine 0·001–0·06 mg. of P in 0·1–1·0 grm. of Al borings. After all air is removed from the apparatus by means of a current of H_2, the sample is dissolved by treatment with 10% HCl. The gases evolved are swept through the apparatus by a current of H_2 and this gas, together with phosphine formed by the action of Al on HCl, is ignited by an electric spark under a well-cooled glass receptacle which serves to condense the H_2O formed as well as P_2O_5. The small quantity of P_2O_5 is determined colorimetrically by matching the blue colour obtained with dilute Mo blue solution. The necessary apparatus is shown as well as described.—S. G.

*__Volumetric Methods of Determining Metals of the Platinum Group.__ A. A. Grinberg and B. V. Ptizin (_Dokladi Akademii Nauk S.S.S.R._ (_Compt. rend. Acad. sci. U.R.S.S._, __1933__, [N.S.], (6), 284–290).—[In Russian and French.] Potentiometric titration of Ir^{III} salts with $KMnO_4$ can be applied not only in pure Ir^{III} solutions, but also in the presence of Rh^{III}, Ir^{IV}, Pt^{IV}, Fe^{III}, and Fe^{II} salts. Potentiometric titration of Ir^{IV} salts with $(NH_4)_2Fe(SO_4)_2$ is useful in the presence of Ir^{III}, Pt^{IV}, Rh^{III}, and Fe^{III}. Pt^{IV} may be determined by reduction to Pt^{II} with a solution of Cu_2Cl_2 in HCl, followed by differential potentiometric titration with $KMnO_4$ in a current of CO_2 in the presence of excess of $MnSO_4$. Pt^{II} and Ir^{III} may be determined simultaneously by potentiometric titration with $KMnO_4$; the presence of Ir^{IV} in the solution has no influence on the result.—N. A.

†**Spectroscopic Analysis: Application to Silicon.** Henri Triché (*Compt. rend.*, 1934, **199**, 419–421).—A method whereby the Si in light alloys is determined by comparing the intensities of the Si line 2881 A and the tin line 2840 A is described. The silicon is brought into an alkaline solution, a known amount of tin added, and a spark passed between the solution and a Zn electrode. This method is satisfactory for concentrations of not less than 0·5% of Si. For lower concentrations, the spark is passed between the alloy and a Sn solution or an arc is passed between the alloy and an electrode containing Sn. This method is not affected by Al.—J. H. W.

***The Effect of Foreign Material on the Potentiometric Titration of Silver.** H. Moser, E. Raub, and W. Stein (*Z. Elektrochem.*, 1933, **39**, 623–627; discussion, 628).—Abstract of a paper read before the Deutsche Bunsen Gesellschaft für angewandte physikalische Chemie e.V. Ag alloyed with other metals was dissolved in HNO_3 or H_2SO_4 and titrated with chlorides, bromides, or thiocyanates. The effect on the titration curves of varying proportions of Fe, Pt, Pd, and Cu was studied.—J. H. W.

***Determination of Tin in [Anode] Sludge.** M. I. Schubin (*Zavod. Lab.*, 1934, **3**, 216–222; *Brit. Chem. Abs.*, **1934**, [B], 678).—[In Russian.] 1 grm. of anode sludge (containing ≮ 0·5% of Sn) from the electrolytic refining of Cu is fused with 3 grm. of Na_2CO_3 and 4 grm. of Na_2O_2, the melt is dissolved in 90 c.c. of H_2O, the solution made acid with 50 c.c. of concentrated HCl and boiled to complete elimination of Cl_2, a further 10 c.c. of concentrated HCl and 2 grm. of Fe are added and the solution is boiled until about 1 grm. of Fe has dissolved, when a further 2 grm. of Fe are added and the solution is cooled and filtered. 45 c.c. of concentrated HCl and 2 grm. of Al are added to the filtrate, which is heated in an atmosphere of CO_2 to dissolution of the Al; then a further 0·1 grm. of Al is added, after dissolution of which 0·5–0·7 grm. of KI and starch solution are introduced, and the solution is titrated (in CO_2) with 0·1*N*-I. Ag, Au, Cu, Sb, As, Bi, Pb, and Fe do not interfere. —S. G.

***On the Volumetric Determination of Zinc.** A. Chiarottino (*Industria chimica*, 1934, **9**, 468–470; *Chem. Zentr.*, 1934, **105**, II, 1655).—After separation of the H_2S metals the solution is oxidized and the Fe, &c., precipitated with NH_4OH. The Zn in the filtrate is precipitated with H_2S in dilute CH_3CO_2H solution, the ZnS collected, washed, dried, and stirred with an excess of freshly precipitated and well-washed $HgCl_2$ whereby the following reaction occurs: $ZnS + Hg_2Cl_2 = ZnCl_2 + HgS + Hg$. The precipitate is filtered off and the Cl' in the filtrate determined by addition of excess of 0·1*N*-$AgNO_3$ followed by titration with NH_4CNS.—A. R. P.

X.—LABORATORY APPARATUS, INSTRUMENTS, &c.

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

(Continued from pp. 512–513.)

***Late Developments in Microscopy.** Francis F. Lucas (*J. Franklin Inst.*, 1934, **217**, 661–707).—The greater part of the paper deals with the application of the microscope to biological problems. The new precision high-power metallographic microscope is briefly described. Use is made of the monobromo-naphthalene objective of NA 1·60, and its superior resolving powers are referred to.—S. V. W.

Illumination in Metallography. A. Fisher (*Machinery* (*Lond.*), 1934, **44**, 711–714).—The conditions which give rise to " glare " with a plane glass vertical illuminator are examined, followed by a short discussion on " critical illumination " and the use of various illuminants. A compact self-contained illuminator, projecting only 2 in. from the microscope, and employing a 4·5-v. bulb, is described and illustrated.—J. C. C.

The Application of Colour Filters in Microphotography and a New Useful Filter Support. G. G. Reinert (*Z. wiss. Mikroskopie*, 1934, **51**, 253–257).—Besides the ordinary liquid, gelatin, and glass filters a description is given of a new "Trichrome" filter which gives a green light with a low content of red rays, and an infra-red filter that is permeable practically only to infra-red rays.—B. Bl.

Electrothermic Laboratory Apparatus of the Chemical Industries. Ludwig Müller (*Elektrowärme*, 1934, **4**, 105–110; *C. Abs.*, 1934, **28**, 4665).—Apparatus and processes for drying, heating of solids and liquids, annealing, &c., are described. Constancy of temperature and temperature regulators are specially emphasized. A molybdenum tubular furnace for 1500° C. and a Tammann induction crucible furnace for 3000° C. are mentioned in particular.—S. G.

***Optical Lever and Furnace for Thermal Expansion Measurements Using Small Specimens.** H. Goulbourne Jones (*J. Sci. Instruments*, 1934, **11**, 325–326).—In this method a small tripod carrying a mirror rests with two legs on a standard specimen, and the third leg on the test-sample. When the whole is heated in a furnace the expansion is deduced from the tilt of the tripod, which is measured by the reflection of light from the mirror. Details are given of the construction of a furnace designed to avoid convection currents. The system measures the expansion of specimens 0·15 cm. long to within $8{\cdot}2 \times 10^{-6}$ cm. Ordinary glass mirrors begin to break down at 200° C., but if heated slowly to 150° C. and then very slowly cooled, they may be used up to 400° C. for a single subsequent heating without appreciable loss of reflectivity.—W. H.-R.

Further Investigations with Bollenrath's Optical Dilatometer. W. Koch (*Metallwirtschaft*, 1934, **13**, 671–672).—The latest modification of the instrument is briefly described and heating and cooling curves are given for pure copper, aluminium, and bismuth. Since in all cases the two curves coincide it is concluded that none of these metals exists in an allotropic modification. —A. R. P.

Heat Conductivity of Metals and Alloys. I.—A New Apparatus for the Determination of the Heat Conductivity of Metals. N. D. Tomashow and J. B. Fridman (*Peoples Commissariat for Heavy Industry, U.S.S.R., United Aircraft Industries; Trans. Sci. Res. Inst. Aircraft Materials*, 1934, (8), 1–19).—[In Russian, with English summary.] The apparatus comprises a cylindrical rod of the material being tested, 12 mm. in diameter and 260 mm. long, enclosed in a heat insulating protective tube and provided at one end with a small internal resistance unit for heating and at the other end with a water-cooling system. The amount of heat passing along the rod is determined from the amount of cooling water and from the electric supply to the heating unit. A series of 9 thermocouples, 4 in the rod, enables readings to be made of the temperature at all the important points of the apparatus. The accuracy of the pyrometric readings is ± 0·1° C. and of the whole apparatus ± 3%. The results obtained on copper, aluminium, "Y" alloy, and other metals are in close agreement with those of other workers.—A. R. P.

***The Use of the Areometer for the Determination of Very Small Changes of Density in Metals.** A. E. Brüchanov (*Metallwirtschaft*, 1934, **13**, 206–208).—The apparatus comprises a hollow glass cylinder (float) with a thin vertical tube terminating in a horizontal pointer sealed into the top, and platinum wires depending from the cylinder for supporting the metal specimen (wire or rod). The depth to which the areometer sinks in a liquid is measured on a vertical scale and with specimens of equal weight provides data for calculating the relative densities. The use of the apparatus for determining the change of density which occurs in drawing steel wire is discussed.—A. R. P.

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

(Continued from pp. 513–517.)

†**Material Testing and Experience.** Fr. Körber (*Z.V.d.I.*, 1934, 78, (6), 195–199).—An extensive review of modern methods of material testing, suggestions for further improvements, and a discussion of the importance of experience in interpreting the results for the evaluation of the quality of the material, with examples.—v. G.

The Standardization of Methods and Norms of Testing Metallic Materials and the Necessity to Establish Precise Norms for Light Alloys. —— (*Alluminio*, 1934, 3, 283–296).—Tentative standard specifications for testing the mechanical properties of metals are given in detail, and some modifications of these are suggested, particularly for use with light alloys.—G. G.

The Photoelectric Measurement of the Diameter of Fine Wire. Richard C. Schmid (*Elektrotech. Zeit.*, 1934, 55, 785–786).—On placing the wire in front of a photoelectric cell part of the light from the source is screened off, the amount of screening being proportional to the diameter of the wire. The corresponding reduction in photoelectric current is therefore a measure of the thickness of the wire. The method can be used for wires and threads 0·5–0·02 mm. in diameter. —B. Bl.

Comparison of Methods for Testing Brass Tubing for Tendency to Spontaneous Cracking. L. Glikman and S. Gontscharov (*Zavod. Lab.*, 1934, 3, 232–242; *Brit. Chem. Abs.*, **1934**, [B], 677).—[In Russian.] Anderson and Fahlman's method (*U.S. Bur. Stand. Tech. Paper* No. **285**, 1925, 235–265) is preferred. —S. G.

New Method of Etching Brass for Revealing Internal Stresses. B. F. Graschtschenko and L. N. Sergeev (*Zavod. Lab.*, 1934, **3**, 243–249; *Brit. Chem. Abs.*, **1934**, [B], 677).—[In Russian.] Etching in an atmosphere of NH_3 is recommended.—S. G.

The Non-Destructive Testing of Welds. S. Kiesskalt (*Indust. Gases*, 1934, **15**, 96–98).—See *Met. Abs.*, this volume, p. 312.—H. W. G. H.

Stress Analysis by X-Ray Diffraction. C. S. Barrett and M. Gensamer (*Phys. Rev.*, 1934, [ii], **45**, 563).—Abstract of a paper read before the American Physical Society. Precision back reflection X-ray photograms have been used by Sachs and Weerts (*J. Inst. Metals*, 1930, **44**, 594) and by Wever and Möller (*Arch. Eisenhüttenwesen*, 1931, **5**, 215) to measure internal stresses in metals. Their calculations give the *sum* of the two principal stresses in the plane of the surface, but not the individual stresses nor their direction. B. and G. have developed a mathematical analysis for the case of the incident beam falling perpendicularly upon the metal surface, in which a measurement of the maximum and minimum diameters of a non-circular Debye ring yields the magnitude and direction of each of the two principal stresses in the plane of the surface. Unfortunately, the Debye rings have so little eccentricity that the authors have not been able to apply this analysis to metals because the width of the diffraction lines has prevented sufficiently accurate measurement of their diameters.—S. G.

†**Determination of the Stress Distribution in Constructional Parts by Elongation Measurements.** F. Rötscher (*Z.V.d.I.*, 1933, 77, 373–378).—The calculation of stresses from measurements of the elongation under different states of stress is explained. The various types of apparatus and procedures for measuring elongation and their use are critically discussed with reference to examples. —K. S.

Determining Inherent Stresses in Large Castings and Forgings. Rene W. P. Leonhardt (*Machinery* (*Lond.*), 1934, **44**, 705–707).—An illustrated description is given of testing equipment developed by Allgemeine Elektricitäts Gesellschaft for measuring accurately the changes in dimensions of a cylindrical specimen after successive annular layers are machined off. Differences in diameter and length can be determined to within 0·005 mm., which is said to be equivalent to a change in stress of 0·5 kg./mm.^{2}.—J. C. C.

The Property of Permanent Set in Certain Non-Ferrous Alloys. J. E. Hurst (*Met. Ind.* (*Lond.*), 1934, **45**, 387–391).—Shrink fits rely on the creation of hoop stresses, in the main, for maintaining assembly. In the case of non-ferrous alloys, plastic deformation under these stresses is made apparent as permanent set, which increases with increase of stress. Permanent set is also greater at the higher temperatures which are often used for interference fits. The permanent set properties can be studied by the procedure outlined for piston rings in B.S.I. specification 5004 and Aircraft Material Specification 4K6. Typical results for a number of centrifugally cast aluminium–bronzes of the plain copper–aluminium type are tabulated, and these show apparent irregularities between the permanent set for 1, 2, and after 16 loadings and the Brinell hardness, which cannot be clearly explained. These results are also compared with those of Monel metal and some light aluminium alloys, and the permanent set is calculated in a number of cases by the method of closing gaps. Elongation values, as usually expressed for these alloys, are no criterion as to their behaviour in this permanent set test.—J. H. W.

***The Influence of Polyaxial States of Stress on the Capacity to Deformation of Metals.** E. Siebel and A. Maier (*Z.V.d.I.*, 1933, **77**, 1345–1349).—The deformation capacity of steel and brass (63 : 37) tubes is decreased by cross-tension. The types of fracture produced under uniaxial and polyaxial stresses are described. It is recommended that the deformation capacity of constructional materials should be determined by measuring the internal stress. Tensile tests under transverse pressure with copper and aluminium rods under normal and high external pressure are described.—K. S.

Effect of Multi-Axial Stressing on the Ductility of Metallic Materials. Anon. (*Metallurgist* (Suppt. to *Engineer*), 1934, **9**, 116–117).—A brief review of the subject, with a summary and discussion of a paper by Siebel and Maier, *Z.V.d.I.*, 1933, **77**, 1345–1349 (see preceding abstract).—R. G.

†The Distribution of Elastic Strain in Metal Specimens. Anon. (*Metallurgist* (Suppt. to *Engineer*), 1934, **9**, 152–153).—A critical discussion and summary of a paper by A. Portevin and M. Cymboliste, *Rev. Mét.*, 1934, **31**, 147–158; see *Met. Abs.*, this volume, p. 513.—R. G.

Determination of Torsional Stresses. A. Thum and W. Bautz (*Arch. tech. Messen*, 1934, **4**, (39), T113–T115).—Disturbances of the ordinary distribution of stresses are most conveniently studied by means of models. The cases here considered are those of shafts of circular section, the diameter varying on account of corrugations, threading, or keying, and of prismatic pieces of any cross-section (*e.g.* angle-bars). The Hele–Shaw and the equipotential types of model testing apparatus are described in connection with shafting, while varying stresses of the second type are evaluated by observations on soap-films. The effects of varying stress on their convexity observed at various points on the surface of the stressed member, optical and mechanical methods of observation are described, as is the Kranz electrical recording device.
—P. M. C. R.

***On the Straining of Lead Water Pipes by Pressure.** Heinz Bablik and Josef Krystof (*Gas- u. Wasserfach*, 1934, **77**, 625–628).—Cf. *Met. Abs.*, this volume, p. 392. Lead water pipes are strained by the static internal pressure and by increase of pressure due to " water hammer " action. Pressure tests in which an elongation of 0·2% was produced in the inner layers of the tube walls showed that alloyed lead withstands a greater internal pressure than soft lead.
—B. Bl.

Creep Testing of Metals and the Application of Creep-Test Data to Industry. Elbert S. Rowland (*Mineral Ind., Pennsylvania State Coll.*, 1934, 3, (4), 1–2; (6), 3–4).—A general discussion.—S. G.

***Increasing the Endurance of Notched Constructional Parts by Internal Stresses.** A. Thum and W. Bautz (*Z.V.d.I.*, 1934, 78, 921–925).—The endurance of a metal can be considerably improved by producing in it a state of internal stress; the polyaxial nature of this stress and the resulting impedance to flow causes notched parts of a metal structure to retain the internal stress better than unnotched parts. The value of various methods of producing internal stress has been determined by fatigue tests; preliminary results of this work are recorded and some practical recommendations are made.—K. S.

†Short-Time Fatigue Testing. H. F. Moore and H. B. Wishart (*Metallurgist* (Suppt. to *Engineer*), 1933, **9**, 75–76).—A summary and discussion of a paper by M. and W. in *Proc. Amer. Soc. Test. Mat.*, 1933, **33**, (II), 234–340. See *J. Inst. Metals*, 1933, **53**, 517; *Met. Abs.*, this volume, p. 360.—R. G.

†Repeated Stress (Fatigue) Testing Machines Used in the Materials Testing Laboratory of the University of Illinois. Herbert F. Moore and Glen N. Krouse (*Univ. Illinois Bull.*, 1934, 31, (30), 7–36).—The following machines are described and illustrated: Sondericker rotating-beam, cantilever rotating-beam, high-speed cantilever rotating-beam, rotating-spring, fatigue testing machine for flat specimens, axial-loading fatigue testing machine, repeated torsion machine and flexure testing attachment, alternating-current magnet-type and inertia-type fatigue testing machines. The preparation of specimens for the machines, the method of carrying out the tests, and the advantages and limitations of the machines are described.—A. R. P.

A Fatigue Testing Machine for the Determination of the Endurance of Test-Pieces and Constructional Parts. H. Oschatz (*Metallwirtschaft*, 1934, **13**, 443–448).—A description is given with reference to diagrams and photographs of the Schenck fatigue testing machine, which is fitted with devices for making alternating bending and torsion endurance tests at low and at high temperatures, as well as under corroding conditions. The grips are arranged for holding cylindrical and other shaped test-pieces and the machine can be used both for static and dynamic tests.—A. R. P.

***Impact Torsion Test (First Report). I.—Impact Torsion Testing Machine II.—General Considerations on the Impact Torsion Test. III.—Impact Torsion Diagrams of Mild Steel and Copper as Tested with Ordinary and Notched-Bar Test-Pieces.** Mititosi Itihara (*Tech. Rep. Tôhoku Imp. Univ.*, 1933, **11**, 16–50).—[In English.] An improved impact torsion testing machine is described with reference to photographs and diagrams; the M/θ diagrams are traced from a combination of two photographic recorders, one showing the twisting moment (M) with time, and the other the angle of twist (θ) with time. M/θ diagrams have been obtained for mild steel and copper from static up to a maximum twisting speed (S) of 860 r.p.m. at room temperature; they show that the yield-point increases with S, and the M/θ diagram approaches a horizontal line which is higher the greater is S. Fracture occurs in the parallel part beside the fillet in the specimen in impact torsion tests and in the fillet in static torsion tests. The sliding speed, calculated by Ludwik's theory of plastic deformation of metals, is constant with constant S but may be accelerated or retarded in impact, tensile, and compressive tests even with a constant hammer velocity.—A. R. P.

***The Torsional Stiffness of Thin Duralumin Shells Subjected to Large Torques.** Paul Kuhn (*Nat. Cttee. Aeronautics, Tech. Notes* No. **500**, 1934, 1–7).—Mathematical. Formulæ and graphs are given for estimating the torsional stiffness of thin shells, *e.g.* box-beams or stressed-skin wings, under large torque loads; it is assumed that the efficiency of the web sheet in resisting deformation decreases linearly with the average stress. Actual determinations are in fair agreement with the results obtained from the empirical formulæ given.—A. R. P.

†**The Effect of Modern Tensile Tests in Practice.** E. Lehr (*Z.V.d.I.*, 1934, **78**, 395–401).—A summary of the papers read at a meeting on material testing held at Essen, Nov. 21, 1933. Works' observations, tensile tests, and new points of view for the calculation and designing of the highly stressed parts of Diesel motors, turbines, and steam boilers are given.—v. G.

***Elongation of Metals at Tensile Test Fracture.** A. K. Cameron (*Commonwealth Eng.*, 1934, **22**, (1), 13–17).—An investigation was carried out to determine a more accurate relation between the percentage elongation and the sectional area and the gauge-length of metals. From theoretical considerations, an equation of the form: $E = K \cdot A^x L^{-y} + C$ for any metal was derived, E being the percentage elongation, A the sectional area, L the gauge length, and K, C, x, and y constants depending on the nature of the metal. From the results of tests carried out, x and y were found to be 0·3 and − 0·6, respectively, for steel.—J. H. W.

***On Plane States of Stress in Metals Immediately Before Tensile Fracture.** Hirosi Yamanouti (*Mem. Fac. Sci. Eng. Waseda Univ., Tôkyô*, **1934**, (10), 1–41).—[In German.] The stress distribution along planes in the constricted area of a tensile test-piece immediately before fracture occurs has been determined on several samples of iron and steel and analyzed mathematically. The results show that for metals of relatively high melting point, fracture is determined by the plane state of stress in the constricted area, the shear fracture surface is always inclined to the base of the specimen and is always slightly rounded, and the maximum breaking load per unit area is always obtained with a circular cross-section. With flat test-pieces the elongation and reduction in area are smaller the smaller is the ratio of thickness to width. The plasticity and strength of a metal are greater the smaller the cross-sectional area.—A. R. P.

Relation of the Size of the Test-Specimens on the Brinell Hardness of Metals. Hirosi Yamanouti (*J. Soc. Mech. Eng. Japan*, 1933, **36**, 835–847; *Mem. Fac. Sci. Eng. Waseda Univ., Tôkyô*, **1934**, (10), 68).—[In Japanese with English summary, pp. S86–S92.] The dimensions of the test-piece have a considerable effect on the value of the constants a and n in the expression $P = ad^n$. From experimental data and from considerations of the relation of the modulus of elasticity and the intensity of the yielding stress (E/σ_f) it is shown that the Brinell hardness of a metal must be measured under conditions such that $D/d > 4$ and $S/t > 6$, where D is the diameter of the ball, d that of the indentation, S the thickness of the specimen, and t the depth of indentation.—A. R. P.

Rockwell–Brinell Conversion Tables. Anon. (*Machinery* (*N.Y.*), 1934, **41**, 35–36).—Gives conversion tables, determined by the Wilson Mechanical Instrument Co., for comparing standard Brinell hardness numbers with all the Rockwell scales, including those of the "normal" and "superficial" testers.—J. C.

RADIOLOGY

Advantages of Radiographic Inspection to Foundrymen. H. R. Isenburger (*Trans. Amer. Found. Assoc.*, 1933, **41**, 502–514; discussion, 514–518).—The practical application of X-rays or gamma rays is indicated and the relative costs and exposure times are compared.—R. B. D.

†**Position and Development of Non-Destructive Testing of Metals.** R. Berthold (*Z.V.d.I.*, 1934, **78**, 173–181).—New forms of X-ray apparatus and tubes are described and their use in the examination of castings, bearings, gas cylinders, conductor wires, and welds is discussed.—v. G.

***Influence of the Divergence of the Primary X-Rays on the Interpretation of Diagrams Obtained by the Reflected Ray Method.** Franz Lihl (*Ann. Physik*, 1934, [v], **19**, 305–334).—The divergence of the incident rays must be taken into account in precision X-ray measurements; correction formulæ are given. —v. G.

X-Rays in Inspection. E. W. Kolb (*Instruments*, 1934, 7, 199–202).—Reprinted from *Radiography and Clinical Photography*. Examples of the use of X-rays in the inspection of railway signalling equipment are described and illustrated. These include the examination of all silver-impregnated carbon contacts by photographing in batches of 1000 on a 14 in. × 17 in. film, the correction of foundry technique by radiographing sample castings, and the examination of butt welds.—J. C. C.

Defect Recognizability in X-Raying. K. Heyer (*Schrift. Hess. Hochschule*, 1934, (4), 79–81).—S. G.

XII.—TEMPERATURE MEASUREMENT AND CONTROL

(Continued from pp. 517–518.)

Industrial Uses of Thermoelectric Pyrometers. A. Schweitzer (*Mem. artillerie franç.*, 1934, **13**, 181–240; *C. Abs.*, 1934, **28**, 6215).—Theory and problems in engineering installations are discussed.—S. G.

Optical Pyrometer. J. Aoki and J. Nishikawa (*J. Fuel Soc. Japan*, 1934, **13**, 878–887).—[In Japanese.] Theoretical discussion.—S. G.

***Rapid Potentiometric Method of Constructing Standard Curves for Working with Kurnakow's Pyrometer.** N. W. Ageew and D. N. Shoyket (*Metallurg* (*Metallurgist*), **1934**, (5), 83–85).—[In Russian.] The method described for constructing cooling curves when using the Kurnakow pyrometer obviates the necessity for frequent standardization against the melting point of pure metals.
—N. A.

The Measurement of Temperature by Means of Photoelectric Cells. J. Zetzmann (*Arch. tech. Messen*, 1934, **4**, (39), T116–T117).—Appropriately selective photoelectric cells are now used as developments of the optical pyrometer. " Alkali " cells are most suitable for the observations of rapidly changing temperatures, vacuum cells being preferable owing to their freedom from lag and greater constancy of the sensitive film, with consequently increased concordance of results. Gas-filled cells are more sensitive, but require very frequent calibration, and overloading easily produces the self-luminous condition, the critical change depending on the nature and pressure of the gas and on the radiation of the cell. Self-luminosity can ordinarily be avoided, but tends to set in if the incident radiation becomes very strong. Semi-conducting and screened cells are unsuitable for pyrometry. The construction, standardization, and degree of sensitiveness of photoelectric pyrometers are discussed and illustrated by specimen curves.—P. M. C. R.

The Determination of Low Temperature with the Hydrogen Gas Thermometer. Sin-Ichi Aoyama and Eizo Kanda (*Kinzoku no Kenkyu*, 1934, **11**, (7), 348–356).—[In Japanese.] A hydrogen gas thermometer of the constant volume type was made for the determination of low temperatures. The thermometer, made wholly of glass, was so constructed that no air contamination through mercury occurs. Errors in temperature determination are discussed. The boiling points of oxygen and nitrogen as well as the sublimation point of carbon dioxide were determined. The copper/nickel–copper thermojunction was calibrated at various low temperatures against this gas thermometer.—S. G.

***A New Photoelectric Temperature Regulator.** B. Lange and E. Voos (*Z. tech. Physik*, 1934, **15**, 323–326).—A sensitive thermo-regulator employing a selenium resistance element and a thyratron for controlling the temperature of furnaces at 1000° C. and higher temperatures to within 0·17° is described.
—J. S. G. T.

†Temperature-Control Systems and Equipment for Electric Heating. P. H. Clark (*Gen. Elect. Rev.*, 1934, **37**, (5), 208–217).—A general review of some of the more important types of thermostats and instruments used in connection with electric furnaces.—S. V. W.

XIII.—FOUNDRY PRACTICE AND APPLIANCES

(Continued from pp. 518–519.

†**Study of Contraction.** Rene Berger (*Cuivre et Bronze*, 1934, **7**, (51), 11–27).—Following a discussion of the factors which influence contraction such as nature of the metal, dissolved gases, condition of the sand, &c., and the evidences of contraction such as internal cavities, internal stress, and reduced dimensions, B. considers the phases through which a casting passes on cooling. He first considers the nature of the sand, whether it yields to the contracting stress of the metal or offers resistance, and offers suggestions for avoiding fractures. He then discusses, rather theoretically, the value of the internal stresses and their origins. On his conclusions he founds a theory of solidification.—W. A. C. N.

***Periodic Structures in Metals and Alloys.** L. Northcott (*J. Iron Steel Inst.*, 1934, **129**, 171–179; discussion, 180–186).—See *Met. Abs.*, this volume, p. 314.—S. G.

Castability or Flowability of Metals and Alloys. A. Portevin (*Bull. Assoc. Tech. Fonderie*, 1932, **6**, 422–427; *C. Abs.*, 1932, **26**, 5889).—Castability or flowability, a complex property, is sometimes confused with fluidity. Fluidity, which is only one of the factors, shows the rapidity with which a metal fills the mould; it depends on a constant temperature, while flowability depends on all general foundry factors. Flowability is influenced by the following factors: (1) nature of mould; (2) temperature of the mould, of metal, and calorific properties of the metal (experimental studies confirm the fact that flowability varies inversely as the difference between the melting temperature of the metal and temperature of the mould; it increases linearly with the temperature of the casting and is notably dependent on the calorific properties of the metal); (3) composition of alloys.—I. M.

Artistic Foundry Practice with the Cire Perdu (Lost Wax) Method. C. Panseri (*Alluminio*, 1934, **3**, 253–262).—The technique of casting statues by the *cire perdu* method is described with reference to numerous photographs illustrating the steps of the process. Besides the usual statuary bronzes it is possible to obtain results of high artistic merit with numerous light aluminium alloys, particularly Anticorodal, and with aluminium–bronzes.—G. G.

Observations of the Behaviour of Molten Metal [Dental Alloys] During Casting. Raymond E. Myers (*J. Dental Research*, 1933, **13**, 275–278).—During pressure casting of dental alloys in investment moulds the following points can be determined if a quartz window is used as one side of the mould: (*a*) rapidity with which the metal enters the mould and spreads through the pattern chamber, (*b*) the sequence of distribution of the metal in the pattern chamber, (*c*) comparative rates of solidification of different parts of the casting; (*a*) depends on the number, length, and diameter of the sprues, the temperature of the flask and of the molten metal, the porosity of the investment material, and the character of the applied pressure, (*b*) on the thickness of the various parts of the pattern chamber and on the diameter and position of the sprues, and (*c*) on the volume of metal in the various parts and on the relation of the sprues to the casting design. (See following abstract.)—A. R. P.

Observations of the Behaviour of Molten Metal During Casting. A Correction of Statements by R. E. Myers. Wilmer Souder (*J. Dental Research*, 1934, **13**, 337–338).—Polemical. A question of priority. (Cf. Myers, preceding abstract.)—A. R. P.

Technical Problems in the Casting of Aluminium. T. Dornauf (*Z.V.d.I.*, 1933, **77**, 941–945).—Practical hints on the melting and casting of aluminium evolved from many years' experience with aluminium. Tensile tests on the strength of aluminium castings are recorded.—K. S.

The Practice of Aluminium Casting. M. Schied (*Z. ges. Giesserei-Praxis : Das Metall*, 1934, **55**, 388–392).—The following points in the casting of aluminium and aluminium alloys are considered : the charge and the testing of its various constituents, the use of graphite or iron crucibles, the operation of melting, the use of zinc chloride as a flux, casting temperatures, preparation of the mould, pouring, gates and risers, denseners, prevention of cracks, and the production of a bright surface.—J. H. W.

***Phenomenon of Crystallization of Aluminium and Duralumin.** M. P. Slavinsky, L. R. Edelson, and A. E. Vol (*Metallurg* (*Metallurgist*), **1932**, (7), 53–67).—[In Russian.] The influence of the shape and size of the mould, the degree of filling, the mould temperature (20°, 75°, 100°, 200°, 300° C.), the presence of impurities (*e.g.*, iron 0·15 and 0·30, copper 0·3 and 3·5, zinc 0·3, silicon, 0·15, 0·30, and 0·50, chromium 0·3, tin 0·15 and 0·30%) on the crystalline structure of ingots of aluminium and Duralumin have been investigated with 156 experimental melts. The direct relationship between the development of a columnar structure and the size of the mould may be distorted or even completely destroyed by the presence of a gas film between the ingot and the mould or by the separation of the mould walls from the ingot. This effect can be avoided by lining the walls with aluminium foil, which renders the use of a lubricant unnecessary, neutralizes the effect on the ingot of the wear of the mould, and assists in the production of a plated ingot.—N. A.

***Investigation of the Optimum Conditions of Crucible Melting and Casting of Duralumin.** S. D. Zipurdeev and N. M. Nadejdin (*Metallurg* (*Metallurgist*), **1932**, (8), 113–120; (9), 67–78; (10–11), 60–68; (12), 56–60).—[In Russian.] The following defects in castings have been investigated : gas bubbles, oxide inclusions, dark spots of liquation zones, setting friability. From melting and casting tests on Duralumin bolts and sheet the following conditions have been evolved : A carefully cleaned and slag-free crucible is charged with ingots of alloy, then with rods of aluminium, the charge is melted and batches and bundles of clean scrap cuttings are added. When melting is complete, the temperature is raised to 740°–760° C., the crucible removed from the furnace, the surface of the metal cleaned of slag and impurities, and zinc chloride (0·10—0·15% by weight of the charge) added; the requisite addition of magnesium is then made and this is followed by a second zinc chloride (0·03–0·05%) treatment. The alloy is cast at 695°–705° C. Sheet moulds are cleaned with Chamotte brick, then dressed with chalk and pre-heated to 100°–180° C. before casting. Bolt moulds are dressed similarly, but preheated only to 40°–60° C. Pouring is done in a thin continuous stream along the narrow wall of the horizontally-placed mould, which is gradually changed to the vertical during pouring. The cast ingots are removed after 5 minutes.—N. A.

Construction Technique of Light Metal Castings. W. Hartl (*Z.V.d.I.*, 1933, **77**, 1355–1358).—Practical hints on casting light metal alloys, especially the softer casting alloys.—K. S.

†On the Production of Aluminium–Copper " Hardeners." Edmund R. Thews (*Metallurgist* (Suppt. to *Engineer*), 1934, **9**, 146–148).—A description of the industrial preparation of " hardener " alloys for addition to aluminium alloys. The pouring of molten copper into molten aluminium has the advantage that the aluminium need not be overheated, but a strong exothermic reaction occurs due to oxide in the copper. It is preferable therefore to deoxidize the copper with a small addition of aluminium or phosphorus. The addition of solid or liquid aluminium to molten copper may cause freezing of the alloy and is not so convenient as the former method.—R. G.

The Rational Use of Aluminium–Bronze. C. H. Meigh (*Found. Trade J.*, 1932, **47**, 234–235; and *Usine*, 1932, **41**, (41), 35–36).—Read at the World Foundry Congress.—S. G.

Design and Construction of Propellers for "Miss America X." E. R. Darby (*Metals and Alloys*, 1932, 3, 246–249).—Because of especially severe requirements, design of propellers was given careful consideration. D. goes into detail as to conditions involved. Metal used in casting the "equipoise" propeller was aluminium–bronze of 88 : 9 : 3 composition, slightly modified by additions of manganese and zinc. Physical properties of this alloy as cast were approximately: tensile strength, 80,000 lb./in.^{2}; proportional limit, 30,000 lb./in.^{2}; elongation, 30%; hardness, 72 Rockwell B. Details of foundry practice involved are given.—I. M.

Can Copper, Tin–Bronze, Red Brass, and Brass be Satisfactorily Melted in a Cupola Furnace? Willi Claus (*Z. ges. Giesserei-Praxis: Das Metall*, 1934, **55**, 349–352).—The theoretical considerations governing the melting of copper, bronze, and brass in a cupola furnace are discussed, especially as regards the effects of gases. The history of the process is traced chronologically, and it is concluded that it is possible to melt these alloys in such a furnace successfully without taking any special precautions.—J. H. W.

Open Discussion on the Production of Brass Ingots. G. L. Bailey and others (*Met. Ind.* (*Lond.*), 1934, **45**, 411–412, 444–445, 451).—Abstract of an open discussion at the Birmingham Local Section of the Institute of Metals. *G. L. B.* stated the desiderata of smoothness and internal soundness in the production of strip ingots of pure brasses for cold-rolling, and outlined the methods by which these could be obtained. He considered that shrinkage caused by high-temperature melting and rapid pouring was preferable to gas-cavities and surface defects caused by low-temperature melting and slow pouring, and recommended the use of the Durville process for the production of the best possible ingots. *R. Genders* discussed the effect of columnar structure on cracking, the effect of the difference in thermal conductivity on the design of cast-iron and copper moulds, the question of dissolved gases in 70 : 30 and 90 : 10 brass, the effect of annealing on the cast structure of brass. *Brazener* confirmed that the use of copper moulds in conjunction with the Durville process comprised the most successful casting method. *H. W. Brownsdon* suggested that the only way to deal with shrinkage cavities was by hot-rolling. *Benton, Williams, Harder,* and *Darwin* raised the question of vibrating the mould during casting. *Molineux* found little difference between vertical and sloping moulds, but *Liddiard* found more than double the number of gas bubbles entrapped with the latter.—J. H. W.

On the Preparation of Sulphur-Free Bronze Alloys. E. T. Richards (*Chem. Zeit.*, 1934, **58**, 402–403).—The chief source of sulphur is the fuel used in melting; in crucible melting in coke fires considerable amounts of sulphur may be absorbed if a poor grade of coke is used; in any case it is preferable to use a mixture of coke and wood charcoal. In cupola melting care should be taken to have the slag on the basic side; a useful slag which melts at 1150° C. and is very fluid contains lime 15, ferrous oxide 42, silica 33% together with manganese oxide to assist in desulphurization. Addition of sodium carbonate to the charge results in a very effective desulphurization; alternatively, the metal from the cupola may be "washed" with fused sodium carbonate or hydroxide and wood charcoal to remove sulphur absorbed in melting. Finally, a little manganese–copper alloy is added just before casting; in this way the sulphur may be reduced to much less than 0·1%.—A. R. P.

The Manufacture of High-Class Marine Propellers. Wesley Lambert (*Inspection*, 1933, **4**, 1–22).—Read before the Institution of Engineering Inspection. See *J. Inst. Metals*, 1933, **53**, 378.—S. G.

Some Notes on Phosphor–Bronze. R. C. Stockton (*Met. Ind.* (*Lond.*), 1934, **45**, 315–317).—A description is given of the raw materials, melting practice, type of mould and disposition of runners, conductivity of the mould, casting temperature, contraction cavities, and method of casting in the manufacture of phosphor–bronze.—J. H. W.

†**Modern Methods of Melting Magnesium Alloys.** A. S. Lugaskov (*Liteinoe Delo* (*Foundry Practice*), **1933**, (10), 11–14).—[In Russian.] The German method of melting magnesium alloys under a layer of molten salts in a crucible, adopted in European machine-building works, guarantees the production of castings with high mechanical properties. If the conditions of the casting process are adhered to, the resistance to corrosion of the castings corresponds with that of alloys melted in an atmosphere of sulphur vapour or gases; the possibility, however, of chance inclusions of salts renders this method unsuitable for the preparation of special anti-corrosion alloys. The simple technique of melting under salt layers and the resulting low oxidation loss justify the high expenditure on crucibles. The latest American technique of melting under reduced pressure of inert gas, without salts, in an electric furnace (necessitating teeming into a ladle for casting), whilst ensuring freedom from salt inclusions does not preclude the possibility of the formation of nitrides, carbides, and oxides, either during the melting process or during pouring into the ladle and casting into the mould. Vacuum melting does not obviate oxide and other inclusions which enter with the metal charge. Melting under a slight pressure of inert gas is technically less difficult than vacuum melting, but none of the vapours and gases used in industry is completely inert to all the constituents of magnesium alloys. None of the technical methods of melting examined can be considered satisfactory.—N. A.

The Practice of Art Casting. Erich Becker (*Z. ges. Giesserei-Praxis: Das Metall*, 1934, **55**, 327–330).—The conclusion of an article on the devices and methods used in moulding for the production of art castings, with special reference to a specific case. Cf. *Met. Abs.*, this volume, p. 437.—J. H. W.

Advances in Zinc Die-Casting Alloys. K. R. Goehre (*T.Z. prakt. Metallbearbeitung*, 1934, **44**, 297–299).—A description of two alloys: (1) Zamak 2, containing aluminium 4·1, copper 2·9, magnesium 0·04, and zinc (pure, redistilled, and containing less than 0·01% lead and cadmium); (2) Zamak 3, an alloy as above but containing no copper. Of these the second exhibits the greater power of resistance against corrosion.—W. A. C. N.

Modern Die-Casting Machines. E. Stevan (*Met. Ind.* (*Lond.*), 1934, **45**, 363–365).—Modern mechanical and hand-operated die-casting machines for zinc–aluminium–copper alloys are described.—J. H. W.

The Properties of Moulding Sands. Their Testing and Classification. J. Lebruly (*Rev. Fonderie moderne*, 1934, **28**, 261–265).—The preparation of specimens for testing, testing for humidity, fineness, cohesion, permeability, vitrification, and miscellaneous tests, such as grain form and chemical analyses, and the classification and choice of sands for moulding are described.
—J. H. W.

Application of A.F.A. Sand Testing by the Producer. C. M. Hardy (*Trans. Amer. Found. Assoc.*, 1933, **41**, 167–174; and (abstract) *Iron Age*, 1933, **132**, 14).—Each sand shipment should be tested for permeability, strength, clay content, and grain distribution by both the producer and the consumer, in order to obtain uniform results from sand control in the foundry, since the variations which occur in the different layers of the deposit must be taken into account in the selection and milling of shipments. Typical analyses and properties are given for various sands and permissible tolerances indicated.—R. B. D.

Oven Drying of Cores and Moulds. E. G. Fiegehen (*Found. Trade J.*, 1934, **51**, 21–23; and *Mech. World*, 1934, **95**, 626–628).—Read before the Institute of British Foundrymen.—S. G.

The Foundryman's Fight Against Waste of Material. L. W. Ludowici (*Z. ges. Giesserei-Praxis: Das Metall*, 1934, **55**, 371).—Summary of a report pointing out how metal is wasted in the foundry and how this may be avoided.
—J. H. W.

The Essentials of Illumination in a Metal Foundry. Cyril Sylvester (*Met. Ind.* (*Lond.*), 1934, **45**, 437–439).—Four different types of unit are considered to be necessary in foundry illumination. These types are briefly described, and examples of the calculations required for adequate lighting of the various parts and machines of the foundry are given.—J. H. W.

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

(Continued from p. 520.)

Recovery of Copper from Scrap of Brass-Plated Iron. V. A. Heifetz (*Zhurnal Prikladnoi Khimii* (*J. Applied Chem.*), 1933, **6**, 653–664; *C. Abs.*, 1934, **28**, 3986).—[In Russian, with German summary.] As soon as the copper has been anodically dissolved, the underlying iron is covered with an amorphous film of oxides on electrolysis in a neutral $Cu(NO_3)_2$ solution. These oxides make the iron passive but raise the potential to + 2·12 v. The passive action of the layer is independent of the current density, and it decreases with the increase in the temperature and becomes stable at 65° C. The joule heat increases to such an extent at a current density in excess of 4 amp./dm.^{2} that the solution heats very rapidly. The resistance of the solution has its minimum at a concentration of 1·0M-$Cu(NO_3)_2$. The energy consumption per ton of cathode copper produced is proportional to the current density, and the proportionality factor is below one. The resistance of the solution is independent of the cation; a decrease in the Cu^{++} and increase in the Zn^{++} does not cause any change in voltage of the cell. The success of the process depends entirely on a proper concentration of Cu^{++} (minimum 35–45 grm./litre). 1 kg./litre of copper may be precipitated from an original copper concentration of 160 grm./litre. The spent electrolyte can be regenerated as follows: by diluting the electrolyte in special purification tanks the iron is entirely precipitated through hydrolysis; the copper is then precipitated as $Cu(OH)_2$ by addition of ZnO.—S. G.

On the Utilization of Copper in Scrap and Furnace Slags. P. S. Belonogov (*Metallurg* (*Metallurgist*), **1932**, (6), 73–77).—[In Russian.] The treatment of copper scrap and copper-containing slags at the Karteret Works of the U.S. Metals Refining Co., N.V., and Hüttenwerke in Oranienburg is described.
—N. A.

Treating Waste from Silver Manufacture. Ernest A. Smith (*Met. Ind.* (*N.Y.*), 1934, **32**, 272–273, 304–305, 341–342).—See *Met. Abs.*, this volume, p. 202.—A. R. P.

Scrap Metal Recovery. G. B. O'Malley (*Chem. Eng. Min. Rev.*, 1934, **26**, 346–347).—The use of Wilfley tables with screening and crushing for the separation of fine brass in sweepings, skimmings, and turnings up to ½-in. size is described.—J. H. W.

XV.—FURNACES AND FUELS

(Continued from pp. 520–522.)

Heat-Treatment of Light Metals. K. Mertens (*Metallwirtschaft*, 1934, **13**, 337–339; and (translation) *Light Metals Research*, 1934, **3**, 17–20).—Since aluminium alloys absorb very little radiant heat, it is advantageous when annealing to use furnaces with ventilators to induce air circulation about the charge so as to accelerate heat absorption by convection. Several furnaces of this type made by different manufacturers are described.—v. G.

A Cross-Channel Resistance Furnace. J. Kuntziger (*Compt. rend. cong. internat. élect.*, 1932, **9**, 290–295; *C. Abs.*, 1934, **28**, 6371).—K. has designed a resistance furnace for melting metal turnings, &c., in which pinch (Hering) and electrodynamic effects are greatly assisted in producing good stirring by the thermo-syphon effect, obtained by making the channels joining the furnace compartments (each compartment being connected to a phase of the supply voltage) oblique rather than horizontal. A brief mathematical theory is given. An experimental 50-kw. single-phase furnace gave good results. —S. G.

The Coreless Induction Furnace as a Laboratory Tool. W. F. McKibben (*Trans. Amer. Found. Assoc.*, 1933, **41**, 66–82).—A brief description of the electrical equipment of a 960-cycle induction furnace plant and the construction of the 100–170 lb. and 25 lb. furnaces used. The crucibles are formed *in situ* from magnesia. Some details of charges are given—mainly devoted to ferrous materials.—R. B. D.

***An Automatic Electrode Regulator for Three-Phase Arc Furnaces.** K. E. Kjolseth (*Gen. Elect. Rev.*, 1934, **37**, 301–303).—S. V. W.

Special Melting Equipment for Foundries. H. Kalpers (*Tech. Blätter deut. Bergwerkzeitung*, 1933, **23**, 672–673).—S. G.

***The Current-Conducting Properties of Slags in Electric Furnaces.—II.** Axel Wejnarth (*Electrochem. Soc. Preprint*, **1934**, Oct., 263–277).—Determinations of the electrical conductivity of various types of complex manganese–alumina–lime–ferrous oxide silicate are tabulated and the bearing of the results on the electrothermal smelting of zinc ores is discussed.—A. R. P.

Electric Furnaces in Russian Industry. L. I. Aronov (*Domez*, **1934**, (2/3), 1–14; *C. Abs.*, 1934, **28**, 6067).—[In Russian.] The total number of arc furnaces in operation in Russia at the beginning of 1934 was 136, with a tonnage of 488 and a current capacity of 196 kw. There are also 18 induction furnaces with a total current capacity of 56,300 kw.—S. G.

Use of Coke-Oven Gas in Melting and Heat-Treating Non-Ferrous Metals. O. Wolff (*Industrie-Gas*, 1931, **3**, 109–115; *Bull. B.N.F.M.R.A.*, 1932, (**40**), 16).—Includes comparative cost figures for the use of coal, producer gas, coke-oven gas, and electricity, in the cases of aluminium, copper, and alloys. —S. G.

XVI.—REFRACTORIES AND FURNACE MATERIALS

(Continued from p. 522.)

***The Action of Gas Atmospheres on Refractory Materials.** S. M. Phelps (*Amer. Refract. Inst. Tech. Bull.* No. **48**, 1934, 1–11; *C. Abs.*, 1934, **28**, 6263).—Studies were made to determine the effects of chlorine, sulphur dioxide, and carbon monoxide on refractories. The gases were allowed to react with the refractories for 72 hrs. at 950° C. The results show an intense influence of gases on their behaviour. A *bibliography* is appended.—S. G.

***High-Frequency Furnace Linings and the Results of the Investigation of Several Lining Failures.** J. E. Priestley and W. J. Rees (*Trans. Ceram. Soc.*, 1934, **33**, 177–199).—S. V. W.

Chromium-Base Refractories. Maurice Déribéré (*Rev. mat. constr. trav. publ.*, **1934**, (297), 101B–104B).—Supplies and sources of chromite are discussed and tabulated. Its high resistance to fluctuations in temperature, chemical attack, and oxidation should render this material increasingly popular as a furnace lining or in manufacturing refractory mortars. A table compares chromite, magnesia, and silica as regards attack between 1000° and 2000° C. by acid and basic fluxes, air, carbonizing and reducing atmospheres, and molten metals, and comparative data respecting melting points, plasticity under 3·5 kg./cm.^{2} pressure, thermal conductivity, and the reactions of the fused product are also given.—P. M. C. R.

***Effect of Method of Manufacture of Magnesite Bricks on Their Properties.** Hermann Salmang and Karl Schnitzler (*Ber. deut. keram. Ges.*, 1933, **14**, 61–84; *C. Abs.*, 1934, **28**, 6262).—The properties of magnesite bricks made from

3 different magnesites when fired at 3 different temperatures (1400°, 1500°, and 1600° C.) and when pressed at 3 different pressures (500, 1290, and 2200 kg./cm.^{2}) were studied. Certain bodies with varied grain-sizes were also fired for 24 hrs. at 1400° and 1500° C. The cold crushing strength was increased by using high pressures in moulding, by increasing the firing temperature, and by using finer-grained magnesite. Firing at 1400° C. for long periods of time had no appreciable effect on the cold strength, but long firing at 1500° C. had a favourable effect. The true commencement of softening under pressure was about 80°–300° C. lower than the apparent softening temperature. Increasing the moulding pressure and increasing the firing temperature usually increased the true softening temperature. Increasing the time of firing at 1400° C. decreased the temperature at which softening started, but firing at 1500° C. for long periods of time increased the temperature at which softening started. The poor resistance of magnesite brick to spalling is attributed to the high thermal expansion of periclase and its poor elasticity. The thermal expansion was linear up to 800° C. and could be reduced as much as 20% with increased firing temperatures and moulding pressures. This decrease may be due to the conversion of some of the MgO into silicate glass. The chief bond was solid solutions of MgO and the spinel $MgO \cdot Fe_2O_3$.—S. G.

***Thermal Expansion of Artificial Graphite and Carbon.** Peter Hidnert (*J. Res. Nat. Bur. Stand.*, 1934, **13**, 37–51; *Research Paper* No. **693**).—There has been a demand for data on the thermal expansion of artificial graphite at elevated temperatures: (1) to calculate the volumes of graphite crucibles used in determining the specific volumes of molten metals and alloys, and (2) for a reference standard in the determination of the thermal expansion of refractory materials. The linear thermal expansion of longitudinal and transverse sections cut from artificial graphite electrodes were investigated at various temperatures between 20° and 1000° C. The average expansion curves of the longitudinal and transverse sections are compared in a figure and a table gives the ranges of the coeff. of expansion for various temperature ranges. The coeff. of expansion of the transverse sections are larger than those of the longitudinal sections. For other conclusions reference must be made to the original paper. Graphite should be selected with care for the purposes indicated above.—S. G.

XVII.—HEAT-TREATMENT

(Continued from p. 522.)

***Air-Quenching of Duralumin Sheet.** S. M. Voronov and S. M. Samdler (*Legkie Metalli* (*Light Metals*), **1933**, (7), 14–27).—[In Russian.] The microstructure and mechanical properties of Duralumin sheet quenched in water at room temperature, in air moving at 1·5–2·5 m./second and in still air has been investigated. Before quenching the sheets were heated in an electric furnace or in a nitre bath, either packed in stacks or separated by gaps of 5–40 mm. The results showed that quenching in water could be completely replaced by quenching in an air current (moving at up to 20 m./second) without any deterioration of the mechanical properties. The optimum temperature before quenching is 510°–520° C. and gaps between the sheets are essential for good results. Air-quenching does not cause warping, but the mechanical properties tend to deteriorate from the edges towards the centre of the sheets.—D. N. S.

***Thermal Treatment of Duralumin Wire.** S. D. Zipurdeev (*Legkie Metalli* (*Light Metals*), **1932**, (12), 35–41).—[In Russian.] Duralumin wires (copper 3·11, magnesium 0·59, manganese 0·57, silicon 0·17, iron 0·61%), 7·49–7·58 mm. in diameter were reduced 55–70% by drawing after various heat-treatments.

On drawing annealed wire the tensile strength increases from 23 to 32·4 kg./mm.^{2}, whilst the electrical conductivity falls somewhat. On drawing wire annealed after quenching the tensile strength rises to 41 kg./mm.^{2}, whilst drawing of quenched wire produces a tensile strength of up to 55·5 kg./mm.^{2}, with, however, a further fall in conductivity. The strength is decreased but the conductivity increased by ageing at 100° C. and still more so by ageing at 150° C.—D. N. S.

***On the Annealing of Duralumin Wire.** S. D. Zipurdeev (*Metallurg (Metallurgist)*, **1933**, (6), 50–52).—[In Russian.] Duralumin wire (3% copper) should be annealed at 370°–400° C., 2–3 hrs. being necessary for a 300–500 kg. charge. The wire should then be furnace-cooled to 250°–270° C., then air-cooled. The changes in the mechanical properties of the wire are shown graphically as functions of the annealing temperature and the temperature at which it leaves the furnace.—N. A.

***On the Adhesion of Commercial Brass Sheets During Annealing in Muffle Furnaces.** S. Kushakevich (*Metallurg (Metallurgist)*, **1932**, (6), 77–78).—[In Russian.] In rolling commercial brass sheets in packets sticking occurs in the centre of the sheets during annealing in muffle furnaces after the sheets have been previously pickled in sulphuric acid. Metallographic investigation and mechanical tests have shown that this adhesion is due to diffusion occasioned by complete removal of air, lubricating material, and oxides from the space between the sheets. To obviate this type of waste, it is sufficient, after rolling of the packet, to separate the sheets and then to repack them. The air thus introduced completely prevents adhesion.—N. A.

Bright-Annealing of Wire in Electric Furnaces. O. S. Haskell (*Wire and Wire Products*, 1934, **9**, 304–308).—Read before the Wire Association (U.S.A.). Consideration is given to the following points in the bright-annealing of wire in electric furnaces: types of furnace available and their respective applications and floor-space requirements, flexibility of equipment, the time cycles of annealing and production, kinds of wire that can be bright-annealed, the production of the proper atmosphere, metallurgical results and surface conditions obtained, and comparative costs.—J. H. W.

XVIII.—WORKING

(Continued from pp. 522–523.)

†Crystal Structure and the Working of Metals with Especial Reference to Elektron. Walther Schmidt [with H. Altwicker, A. Beck, H. Bothmann, W. Schmidt, E. Schmid, W. Schultze, and W. Spitaler] (*Z. Metallkunde*, 1933, **25**, 229–236).—Hints for the practical working of Elektron are deduced from the crystallographic properties of magnesium, the mechanism of its deformation, the effect of temperature thereon, the effect of rate of deformation, twin formation, and grain size. Elektron should be worked at above 225° C., since then slip occurs not only along the hexagonal basal plane but also along pyramid planes. In rolling a speed of 8–10 m./minute gives the best results. The production of a fine-grained metal is essential to overcome the effects of the formation of an oriented structure on the mechanical properties; this is obtained in extrusion presses either at the slow speed of 0·6 m./minute or at the normal speed of 3–5 m./minute by quenching the metal with water as it leaves the die, thus preventing spontaneous recrystallization. Forgings should be alternately hammered and stretched by 10%. The intermediate stretching serves to bring a portion of the crystals into a position favourable to translation. For the production of sheets extruded rods should be used since they have a more suitable crystal orientation than rolled ingots. The last heat-treatment of the sheet should be given after 10% reduction by cold-rolling. Alternate bending of finished sheets in the direction of rolling leads to twinning and an improvement in mechanical properties. A similar effect is obtained by cross-rolling extruded rods. An explanation is given of the high damping capacity of Elektron under alternating stresses.—B. Bl.

The Plastic Forming of Metals. Erich Siebel (*Steel*, 1934, **94**, (12), 28–30; (13), 38–41; (14), 25–28; (15), 40–44; (16), 42–46; (17), 40–45; (18), 39–42; (19), 51–54; *C. Abs.*, 1934, **28**, 6670).—Cf. *Met. Abs.*, this volume, p. 460. Investigations are made of distribution of deformation and stress in technical forming processes: (1) condition of deformation after termination of forming; (2) distribution of deformation and stress in drawing, pressing, and piercing; (3) distribution of stress in forging and rolling; and (4) stress relations in the skew rolling process.—S. G.

***Relation Between Plastic Deformation in Deep Drawing and Tensile Properties of Various Metals.** M. H. Sommer (*Metals Technology*, 1934, **1934**, (Feb.), *A.I.M.M.E. Tech. Publ.* No. 541, 1–19).—Attempts are made to correlate the deep drawing properties of metals with the results of tensile tests. (1) The ordinary stress–strain curve based on the original cross-section of the specimen is unsuitable, and a curve taking into account the local contraction is essential. As usually defined, the "actual stress–strain curve" gives the actual unit stress plotted against percentage reduction of area, but for S.'s purpose it is more convenient to base the actual stress–strain curve on the actual elongation at the point of greatest contraction, which can be calculated from the reduction in area. From this curve a "modified stress–strain curve" is obtained in which the ordinates are the actual stresses divided by the nominal ultimate tensile strength of the metal considered, and these curves are compared. (2) The action and reaction when a flat disc is drawn into a shell by the action of a punch are analyzed. There are three distinct forces which act on the blank to deform it to the shape of the shell, and of these the most important is the composite stress compressing the portion of the flange that must be dislodged (cf. S. "Versuche Über das Ziehen von Hohlkörpern," V.D.I. Verlag, Berlin, 1926). (3) Other factors being equal the deep stamping qualities of any metal are in inverse proportion to the position of its modified stress–strain curve as defined above, and are in inverse proportion to the resultant compressive stresses divided by the nominal ultimate strength. These points are illustrated by curves for brass (72·30 % Cu), copper, aluminium, iron, and ferrous alloys. The conclusions are in agreement with experiment and actual practice, and are confirmed by Erichsen tests.—W. H.-R.

***Relations Between the Deep-Drawing and Tensile Properties of Various Metals.** M. H. Sommer (*Z.V.d.I.*, 1934, **78**, 1195–1201).—An attempt has been made to correlate the stress–elongation curve of a metal with its behaviour on deep-drawing.—v. G.

The Pressure-Depth of Penetration Diagram as a Characteristic of the Deep-Drawing Process. New Tests with the Erichsen Sheet-Testing Apparatus. A. H. F. Goederitz (*Z. Metallkunde*, 1934, **26**, 49–55).—In the deep-drawing of cups of open-hearth iron strip, 63 : 37 brass, silver, electrolytic copper, zinc, and aluminium in two stages in the Erichsen apparatus the pressure of the ram and the holder at various depths of penetration has been determined for various sheet thicknesses and diameters, and die diameters. In all cases the power required reaches a minimum at a certain die diameter and both the pressure on the ram and of the holder pass through maxima during the drawing process; this behaviour is particularly prominent with metals, like iron and brass, which have a high tensile strength. These maxima in the pressure are probably due to a tendency to wrinkling. In both pressure–depth of penetration curves other less marked maxima or irregularities occur in the later stages of drawing; these are attributed to the pulling of local accumulations of metal through the die and, in the second stage of the drawing, to the formation of points.—B. Bl.

Preventing Breakages in Drawn Shells. C. W. Hinman (*Canad. Mach.*, 1934, **45**, (10), 13–14).—The principal causes of rupture in drawn shells are enumerated, and directions are given for the annealing of materials of low-melting-point and for the lubrication of copper, zinc, and aluminium during drawing.—P. M. C. R.

On the Technology of Stamping. K. M. Dolezalek (*Z.V.d.I.*, 1934, **78**, (29), 871–874).—A new pressure measuring method is described for determining the pressure changes in the shear cutting of metals; the method makes use of the fact that the magnetizability of certain nickel steels depends on the mechanical state of stress. The apparatus used in the tests, the technique, and some preliminary results are described with reference to diagrams and tables.—K. S.

***Investigation of the Conditions of Producing Copper Tubes [Rods] by Pressing from the Point of View of Quality.** V. V. Zholobov (*Metallurg* (*Metallurgist*), **1934**, (4), 82–88).—[In Russian.] In the pressing of copper rods the scrap produced should not amount to more than 8% of the weight of the ingot. The microstructure of the scrap has been investigated. [*Note by Abstractor:* The word " tubes " is printed in error in the title; all the work was carried out on rods.]—N. A.

The Rolling and Extrusion of Aluminium and Its Alloys. Robert L. Streeter (*Trans. Amer. Soc. Mech. Eng.*, 1933, **55**, IS 55–57, 51–59; and (abstract) *Machinery* (*N.Y.*), 1933, **39**, 540–541).—S. outlines the history of the development of the manufacture of aluminium sheet, wire, and rod, and discusses the growth of the demand for aluminium alloys and the problems that research laboratories and engineers had to solve before the manufacture of these alloys became practicable. A description is given of mills for rolling standard structural shapes, with reports on tests made to ascertain the power required to roll strong alloys. The extrusion of aluminium alloys is discussed, touching on the reasons for using extrusion in place of rolling, and explaining the limitations of the extrusion method of manufacturing shapes.—I. M.

***The Broadening of Copper in Connection with the Rolling of Flat Billets from Wire-Bars.** M. I. Zlotnikov (*Metallurg* (*Metallurgist*), **1934**, (6), 102–109).—[In Russian.] The influence of the backing, thickness, degree of reduction, and diameter of the rolls has been investigated on a works' scale.—N. A.

***The Rolling of Copper on the Mannesmann Stand.** V. V. Zholobov (*Metallurg* (*Metallurgist*), **1934**, (4), 88–96).—[In Russian.] The theory of oblique rolling is explained and an experimental verification given. In the process of piercing the condition of the ingot has a great influence on the properties of the tube. The temperature of rolling (750°–850° C.) has no appreciable influence either on the power consumption or on the quality of the finished article.
—N. A.

Smelting, Casting, and Rolling of Electrolytic Copper. Roy H. Miller and W. S. Adams (*Wire and Wire Products*, 1934, **9**, 322–329, 349–351).—Read before the Wire Association (U.S.A.). The refining, casting, and rolling of electrolytic copper on a large scale are described simply but at some length.
—J. H. W.

***The Hot-Rolling of α-Brass.** S. A. Kushakevich (*Metallurg* (*Metallurgist*), **1932**, (9), 83–97; (10–11), 68–77).—[In Russian.] Works' experiments on the hot-rolling of α-brass and the resulting mechanical properties of the rolled brasses are described. The results are given in tabular form.—N. A.

Notes on Nickel and Monel Metal. Max Thiele (*Illust. Zeit. Blechind.*, 1934, **63**, 1110–1112).—Working conditions and temperatures are summarized for the rolling, forging, drawing, pressing, annealing, pickling, surface treatment welding, and soldering of nickel and Monel metal.—P. M. C. R.

***Testing the Drawing Properties of Rolled Zinc Alloys.** E. H. Kelton and Gerald Edmunds (*Metals Technology*, **1934**, (June), *A.I.M.M.E. Tech. Publ.* No. 545, 1–8).—The construction of a set of combination tools for determining the deep-drawing properties of rolled sheets of high-zinc alloys is described, and some results obtained with it are shown in tables and graphs; they show that the drawing quality of these alloys bears no relation whatever to the dynamic ductility, dynamic cold bends, temper, hardness, tensile strength, or elongation. For the alloy of zinc with 1% copper and 0·01% magnesium the drawing quality is at a maximum in the hard-rolled state with a 20–50% reduction, and in the annealed state after a 25–35% reduction by cold-rolling. —A. R. P.

***The Relation of Cold-Working and Annealing to the Mechanical Properties and Structure of Bimetal: Iron–Tombak.** D. G. Butomo and S. A. Kushakevich (*Metallurg* (*Metallurgist*), **1933**, (7), 75–82).—[In Russian.] Methods of obtaining the best working properties of the bimetal iron–Tombak are described, with special reference to the effect of deformation at 10°–300° C. and subsequent annealing for 1–3 hrs. at 500°–700° C. on the mechanical properties and microstructure; 650° C. is the best annealing temperature. The mechanical properties are determined by the size of ferrite grains. A reduction of not less than 30% by cold-working is desirable.—N. A.

Determination of the Interval of Plasticity of Heated Alloys for Hot-Rolling. P. I. Graduzov (*Zavod. Lab.*, 1934, **3**, 365–367; *Brit. Chem. Abs.*, **1934**, [B], 678).—[In Russian.] Methods are described.—S. G.

***On the Theory of Determining the Work of Rolling.** Ig. M. Pavlov (*Metallurg* (*Metallurgist*), **1932**, (8), 84–103).—[In Russian.] A generalized development of typical formulæ for expressing the work of rolling is given. The significance of the discrepancies in the theories of different authors is examined. An expression connecting the engaging, friction, and critical angles is evolved. —N. A.

***An Apparatus for Determination of the Pressure of Metal on the Rolls During Rolling and Forces During Drawing.** S. Kochkin (*Metallurg* (*Metallurgist*), **1934**, (2), 59–65).—[In Russian.] The apparatus which is based on elastic deformation measurements is described and illustrated.—N. A.

Expressions for Calculating the Principal Processes in Rolling. Hubert Hoff (*Z.V.d.I.*, 1934, **78**, 1092–1093).—Mathematical expressions are given for calculating the pressure and power required for rolling.—v. G.

***Study of Elongation During Cold-Rolling.** Ig. M. Pavlov, Y. S. Gallay, and N. V. Silin (*Metallurg* (*Metallurgist*), **1934**, (4), 6–36).—[In Russian.] The centre-punch method has been used for the experimental determination of the degree of stretching or elongation in rolling. The coeff. of friction has been determined by Pavlov's expression $K = \frac{T}{2P} + \tan\frac{\alpha}{2}$, where T is the force pulling the metal into the rolls, P the vertical pressure of the metal on the rolls, and α the angle of grip. Dry and unpolished rolls produce a high stretch. The properties of metals influence the stretch only indirectly, but act directly on the coeff. of friction. Thin strips give a large degree of stretch. The curve expressing the relation of the amount of stretch to the thickness is a hyperbola. With increase in reduction the curve becomes a parabola. The width of the strip does not influence the amount of stretching. Large-diameter rolls produce greater stretching. The only correct expression for determining the degree of stretching is that due to Fink.—N. A.

***Investigation of Natural Angles of Grip During the Rolling of Non-Ferrous Metals.** Ig. M. Pavlov and N. N. Get (*Metallurg* (*Metallurgist*), **1934**, (5), 52–66).—[In Russian.] In hot-rolling the surface conditions of the rolls has the biggest influence on the magnitude of the angle of grip. This angle increases with decrease of temperature of the rolls, as the hardness of the metal being rolled increases. In cold-rolling the greater the width of the rolled metal and the harder the material, the smaller is the angle of grip. For ribbon-rolling in mirror-polished rolls the angle of grip is usually 2°–3°, but never exceeds 4°.

In hot-rolling non-ferrous metals the angles of grip are determined by the roughness of the rolls and vary from 8°–10° to 28°–30°.—N. A.

***Precision Rolling** [**of Metals**]. Albert Noll (*Stahl u. Eisen*, 1934, **54**, 893–898).—The increasing demand for rolled metal of uniform dimensions over the whole length is emphasized, and sources of error discussed. The deformation of metal passing through rolls with grooves of different shapes is described in detail and illustrated diagrammatically. The cooling of the metal during the rolling process results in the first part of the metal being rolled at a higher temperature than the last part, and N. discusses the effect of this on the variation in dimensions of the rolled product and the use of automatic compensating devices to eliminate this source of error.—W. H.-R.

***On a Modification of the Sachs Equation for the Determination of the Drawing Force.** V. Zverev (*Metallurg* (*Metallurgist*), **1934**, (4), 96–98).—[In Russian.] A modification is introduced into the Sachs equation for the determination of the drawing force. The results obtained by the modified equation differ by a maximum of 3% from those obtained by the Sachs equation.—N. A.

***Study of Factors Influencing the Final Mechanical Properties of Drawn Duralumin Tubes.** M. I. Kovarskiy and V. E. Prihodov (*Metallurg* (*Metallurgist*), **1934**, (3), 57–66).—[In Russian.] The influence of preliminary cold-working, air-quenching, and degree of deformation and the relation between deformation and time interval after hardening on the mechanical properties of Duralumin tubes have been studied.—N. A.

***Investigation of Stress, Drawing, and Wall Thickness in the Drawing of Copper Tubes Without a Mandrel.** V. A. Kochkin (*Metallurg* (*Metallurgist*), **1934**, (6), 81–102).—[In Russian.] The pressure-flow changes parabolically with the degree of deformation, decreasing with increase in deformation to a minimum, then increasing again. The degree of deformation at which this minimum occurs increases linearly with the angle of the die. The pressure flow decreases with increase in this angle to a minimum which, for annealed copper tubes in oiled steel dies, is about 5°; with a greater angle the pressure of flow increases again but for practical purposes an angle of 10° is the most convenient. In favourable conditions, the pressure of flow varies within narrow limits (30–35 kg./mm.^{2}).—N. A.

***Determination of the Power Required for the Drawing of Tubes.** N. M. Zamutaly (*Metallurg* (*Metallurgist*), **1933**, (9), 62–70; (10), 49–57).—[In Russian.] The theoretical aspect is discussed and the application of theoretical principles to the drawing of tubes of copper, 70 : 30 and 65 : 35 brass and Duralumin is investigated. The power required in drawing is $P = ApD^2$, where A is a constant depending on the amount of reduction during drawing, p the strain in the wire after passing the die, and D the diameter before drawing.—N. A.

Lubrication for Drawing Copper Wire. John G. Richards (*Wire and Wire Products*, 1934, **9**, 338–339, 355).—The requirements for heavy, medium, and fine copper wire drawing are set out. A lubricant which is suitable for heavy wire will work as satisfactorily on intermediate and fine gauges if properly diluted, but the latter sizes can also be drawn with lubricants containing less free fat and a higher soap content.—J. H. W.

***The Production and Properties of Manganin.** S. A. Pogodin and E. M. Lekarenko (*Metallurg* (*Metallurgist*), **1933**, (1), 70–83).—[In Russian.] Manganin is melted in graphite crucibles and in a crude-oil furnace. Electrolytic copper and nickel are first alloyed in the covered crucible under a layer of charcoal, and the manganese, preheated to 300°–400° C., is then introduced. The casting temperature is about 1080°–1100° C. and the surface of the ingots is planed to remove surface defects. Before rolling, the ingots are soaked for 1 hr. at 800°–850° C. During rolling, it is essential to use only small reductions in the first 3–4 passes but thenceforward the rolling down to 6·5 mm. is continued as for copper. Prior to drawing the rolled piece is annealed at 700°–750° C. for 1·5 hrs., and pickled at 60°–70° C. in 10% sulphuric acid containing 2% of chromic acid. Drawing is carried out as for copper, with intermediate anneals at 650°–500° C. and a final anneal at the same temperature. Annealed Manganin has a minimum tensile strength of 42 kg./mm.², elongation 20%, specific electrical resistance 41 μΩ/cm.³, thermal coeff. of electrical resistance ± 0·00001–0·00003 with a maximum thermo-electric power of 1μV/1°.—N. A.

***Experiments on the Working of Manganin into Wire.** S. D. Zipurdeev (*Metallurg* (*Metallurgist*), **1933**, (1), 83–92).—[In Russian.] A large ingot of 53–54 kg. is cast at 1080°–1120° C. into a cast-iron mould (temperature 120°–150° C.) and hot-rolled at 790°–810° C. into a 7-mm. wire, which is finished at 550°–600° C. The wire is drawn at a speed of 35–40 up to 75–82 m./minute. Hot-rolled and drawn wire of 3·45 mm. is annealed at 750°–800° C., and thin wire (1·0 mm.) at 700°–750° C. The best pickle is 10–15% sulphuric acid at 40°–60° C. The changes in the properties of Manganin wire with annealing temperature are given in tables and a diagram.—N. A.

***The Production of Nichrome.** S. A. Pogodin, A. I. Bass, G. A. Kagan, E. M. Lekarenko, and V. I. Miheeva (*Metallurg* (*Metallurgist*), **1933**, (2), 15–26; (3), 19–35).—[In Russian.] Information is given on suitable compositions of the alloy, the purity of the raw materials, and the melting, casting, hot-forging, and cold-rolling of the alloy. From the results of works' tests a procedure is worked out for the production of Nichrome ribbon.—N. A.

***Experiments on the Drawing of Nichrome.** S. A. Pogodin and E. M. Lekarenko (*Metallurg* (*Metallurgist*), **1933**, (6), 36–42).—[In Russian.] A description is given of methods of drawing and annealing of rolled billets of Nichrome, including drawing in a copper sheath. A scheme of drawing based on the results of numerous experiments is outlined.—N. A.

Theoretical Bases for the Wire-Drawing Process. M. O. Kornfeld (*Metallurg* (*Metallurgist*), **1932**, (12), 15–29).—[In Russian.] Published data on the determination of the power required in drawing and the optimum size of the die are examined. The limiting degree of reduction in area during drawing is analyzed. To prevent breaking of the wire, the ratio of the drawing power (P) to the strength of the wire (σ_2) on emerging from the die must be less than 1. This ratio (P/σ_2) is represented by ϵ and is known as the coeff. of reserve. For a thin wire the limiting value of ϵ is 0·60 and for a thick wire 0·7–0·8. As a first approximation ϵ depends only on the degree of reduction in area. An apparatus for the rapid determination of ϵ for various drawing dies is described. The drawing process on multi-pass installations is discussed.—N. A.

The Drawing of Fine Wires by Means of Diamond Dies. P. Grodzinskii (*T.Z. Prakt. Metallbearbeitung*, 1934, **44**, 228–232).—Diamond dies are used in drawing the finest wires, whereas tungsten carbide or steel dies are used in the coarser drawing. Appropriate sizes of diamond dies for copper wires are tabulated. The efficiency of drawing is affected by the following factors: the nature of the material to be drawn and its previous treatment, the reduction of area at each draft, speed of drawing, lubrication, methods of cooling, condition of dies, fracture and fatigue of the diamonds. The process of drawing is considered mathematically. Ferrous materials normally require a longer entrance to the die than non-ferrous ones. A description is given of the preparation of the dies.—W. A. C. N.

New [Wire-Drawing] Machines for Metal Works. Hermann Obermüller (*Metallwirtschaft*, 1933, **12**, 437).—Illustrations and brief descriptions are given of a strip–wire drawing machine for copper and brass, an electric saw, and a draw-bench for copper and aluminium wires up to 8 mm. in diameter. —A. R. P.

***Cutting Tools Research Committee. Report on the Heat Conductivity and Hardness of Carbon and High-Speed Steel. Also the Durability of these Steels when Cutting Brass. [Hardness of Brass at High Temperatures.]** Dempster Smith and Arthur Nield (*Proc. Inst. Mech. Eng.*, 1932, **123**, 709–725).—A report the interest of which is mainly ferrous. Pendulum hardness tests at temperatures up to 300° were made on brass in the " as cast " state, the composition of the alloy being copper 70·44, zinc 26·81, lead 2·20, iron 0·36% with a trace of tin. The amount of work hardness is exceptionally high, but full details are not given.—I. M.

The Estimation of the " Cuttability " of Metals. H. Schallbroch (*Z.V.d.I.*, 1933, **77**, 965–971).—A review of recent literature on the subject.—K. S.

†Dynamic Processes of Cutting [Metals] and Their Influence on the Surface Appearance. Walther Leyensetter (*Z.V.d.I.*, 1933, **77**, 1376–1377).—From measurements of the variations in speed and pressure during cutting and from photographs of the surface appearance of the metal it is concluded that a small feed, small depth of cut, and high speed of cutting give a surface free from fissures. With low cutting speeds a relatively deep layer of deformed metal is produced; this defect is overcome with high cutting speeds.—K. S.

***On the Determination of the Temperature Range in Turning.** Friedrich Schwerd (*Z.V.d.I.*, 1933, **77**, 211–216).—Measurements of the temperature of tool and metal have been made by Herbert Gottwein's thermoelectric method in which, instead of direct temperature measurements, determinations are made of the potential differences at various points of contact between the tool and the metal, and thus mean temperatures can be ascertained. Sketches and diagrams of the apparatus used are given.—K. S.

The Advantages of the Latest Cutting Materials [Cemented Carbides]. W. Muirhead (*J. Inst. Production Eng.*, 1934, **13**, 285–302).—Examples are given of the use of tungsten carbide tools in a variety of circumstances.—J. C. C.

XIX.—CLEANING AND FINISHING

(Continued from pp. 523–524.)

***On the Mechanism of the Electrolytic Degreasing of Metals.** B. Kabanov (*Zhurnal Fizicheskoy Khimii* (*J. Phys. Chem.*), 1933, **4**, (5), 549–553 (in Russian); and *Kolloid.-Z.*, 1933, **65**, 101–105; *Chem Zentr.*, 1934, **105**, II, 663).—The wettability of metals by water is increased by cathodic polarization and hence the removal of fats or oils is facilitated. In the case of mercury cathodic polarization without any gas evolution is sufficient to clean the surface from grease; this is illustrated by photographs of the gradual removal of vaseline drops from a mercury surface as the polarization potential is gradually increased to 0·85 v. Tests on iron and platinum show that gas evolution is essential for the efficient cleaning of solid surfaces; immediately a cathode of greasy metal is introduced into the electrolyte with the current on, the grease begins to collect into oily globules.—A. R. P.

Solvent Degreasing. M. Marean (*Monthly Rev. Amer. Electroplaters' Soc.*, 1934, **21**, (2), 31–37; discussion, 37–40).—A discussion of the advantages of degreasing with trichlorethylene in the vapour phase.—A. R. P.

Chemical Cleaning of Non-Ferrous Metals. Hugo Krause (*Maschinenbau*, 1934, **13**, 187–189).—Cleaning solutions for copper, nickel, zinc, tin, lead, aluminium, and their alloys are described.—K. S.

***Removal of Surface Oxides by Pickling.** F. N. Aleshin and S. D. Zipurdeev (*Metallurg* (*Metallurgist*), **1934**, (2), 55–59).—[In Russian.] Pickling in sulphuric acid proceeds slowly for brasses, and does not effect sufficient removal of oxides for phosphor–bronze and Constantan. Addition of potassium nitrate considerably improves and intensifies the action of the pickle on brasses and phosphor–bronze, whilst further addition of sodium chlorate ensures a satisfactory cleaning of Constantan. The best temperature is 80°–100° C. To remove the copper sulphate film from the phosphor–bronze or Constantan a mixture of sulphuric and nitric acids is used.—N. A.

Finishing Bronze and Brass Statues. E. N. Bintner (*Monthly Rev. Amer. Electroplaters' Soc.*, 1934, **21**, (3), 31–39).—A plea is made for the better preservation of metal statues in American cities, and three recipes are given for producing artificial patinas on bronze and brass.—A. R. P.

Aircraft Finishing. M. W. Mason (*Indust. Finishing*, 1934, **10**, (5), 18–22; (6), 16–20; (7), 16–20; (8), 32–35).—Among other matters, data are given briefly concerning the cleaning and finishing of structural metal parts.—S. G.

Attempts to Produce Relief Patterns by the Direct Electrographic Effect. Elizabeth Wilcox and P. H. Carr (*Phys. Rev.*, 1934, [ii], **45**, 286).—Abstract of a paper read before the American Physical Society. The fact that the surfaces of many metals which have been exposed to cathode rays are rendered less active chemically towards corrosive vapours is termed the direct electrographic effect. Attempts to take advantage of this effect to produce a pattern in relief have been only partially successful. In these experiments a portion of the metal surface is protected by means of a stencil during the exposure in air to 100-kv. cathode rays. An attempt is then made to develop the image of the stencil on the metal by use of a suitable reagent and directly or indirectly to build the image in relief. Results confirm previous reports that water vapour is helpful if not essential to satisfactory development. On silver, copper, tin, zinc, lead, brass, and bismuth the inorganic materials investigated prove better developers than organic materials. The image was not rendered in relief by electroplating directly after exposure on any material except carbon. Attempts to produce the relief by first developing in the ordinary way and then electroplating failed except when anthraquinone was the developer. Cadmium vapour as the developer produces images of low relief directly.—S. G.

XX.—JOINING

(Continued from pp. 525–526.)

Notes on Dural Riveting. Roland V. Hutchinson (*Machinist* (*Eur. Edn.*), 1934, **78**, 638–639).—The mechanism of riveting with Dural rivets and its effect on the choice of suitable conditions for the operation are discussed.—J. H. W.

The Procedure for Flange Soldering Applicable to Light Alloy Sheet. J. Lancrenon (*Rev. Aluminium*, 1934, **11**, 2531–2532).—It is difficult to weld large sheet assemblies owing to the inevitable deformation of the sheet, especially in the case of metals which are good conductors of heat. The difficulties have been overcome in the case, for example, of a 7% magnesium–aluminium alloy, by lightly hammering the edges of the sheet to shape and forming small cavities in the rounded portions. These cavities resist deformation and, becoming filled with the deposited metal, act as ribs which reinforce the assembly.—J. H. W.

Solders and Soldering Fluxes. A. J. T. Eyles (*Hardware Trade J.*, 1934, **157**, 86–87).—For soft soldering tin- and terne-plate, brass, copper, nickel, and Monel metal, zinc chloride or resin should be used as flux. For galvanized iron and steel, hydrochloric acid is recommended, and no flux at all is necessary for aluminium, should one wish to solder it. The best flux for hard soldering is fused borax. Tables are given showing the most suitable solders and fluxes for various materials.—H. W. G. H.

Soldering of Mass Produced Articles [Jewellery]. Jon Wenz (*Maschinenbau*, 1934, **13**, 241–242).—Modern procedures are described.—K. S.

Points of View for the Selection of Methods of Joining Aluminium, and the Necessary Materials Therefor. L. Rostosky (*Metallwirtschaft*, 1934, **13**, 516–518, 532–533).—A discussion of modern methods of autogenously welding, and of hard- and soft-soldering aluminium, pointing out their advantages and drawbacks, and giving hints for obtaining strong, corrosion-resistant joints. —A. R. P.

Fusion Welding of Aluminium. Hugo Buchholz (*Maschinenbau*, 1934, **13**, 137–141; appendix, 194).—The following points are discussed with reference to examples: the effect of gases, peculiarities in alloys, heat-treatment of welds, tensile properties, recrystallization. Autogenous welding is compared with hammer-welding.—K. S.

Welding Repair of a Cast Aluminium Engine Casing without Pre-Heating. Paul Weissner (*Automobiltech. Z.*, 1934, **37**, 473).—An account of the repair by acetylene welding of a hole 6 in. × 4 in. in a motor-engine casing. No heating furnace was available, and the work was brought to the required temperature by suitably adjusted welding burners, the approximate temperature of various parts being indicated by the changing appearance of blue-pencil markings. Preparation, use of burners, and cooling precautions are described. —P. M. C. R.

Reclaiming Large Bronze Casting by Welding. W. F. Barron (*Welding*, 1934, **5**, 339–340).—Corroded areas in a vessel of acid-resisting bronze were chipped out and built-up by the oxy-acetylene process, with Everdur bronze. A fireclay mould was made as backing for the weld metal, and this was built round a beeswax core which was melted away during preheating. —H. W. G. H.

Points of View for the Selection of Joining Methods [for Metals], and the Necessary Materials Therefor. L. Rostosky (*Metallwirtschaft*, 1934, **13**, 582–583).—Practical hints on welding and soldering magnesium and other non-ferrous metals.—A. R. P.

Causes of the Non-Weldability of Nickel. A. Boutté (*Rev. soudure autogène*, 1934, **26**, (246), 6–7).—The weldability of nickel is found to depend mainly on the ratio of magnesium content (less 0·02%, which is usually in solution) to sulphur. This should not be less than 5. The silicon content should not be less than 0·2%.—H. W. G. H.

Contraction Stresses in Fusion-Welded Parts. G. Bierett and G. Grüning (*Autogene Metallbearbeitung*, 1934, **27**, 259–266).—Except in cases in which the parts are under stress during welding, the contraction stresses caused by welding are considered to be greater when a concentrated zone of heat is produced, as in arc welding, than if the volume of heat supplied is large, as in flame welding. Experiments are described to imitate the conditions often obtaining in the repair of vessels by fusion welding. Small discs are welded into holes of the same diameter in flat sheets, and the stresses produced in the latter are measured by cutting the plate into pieces. It is found that there is no advantage in using a concentrated source of heat and, moreover, re-heating the weld seam is beneficial.—H. W. G. H.

***Internal Strains in Weld Seams.** Franz Bollenrath (*Stahl u. Eisen*, 1934, **54**, 873–878).—The experiments refer to steels, but the investigation of strains in welds is of general interest.—W. H.-R.

Distribution of Temperature and Stress in Plates Welded by Different Processes. Maurice Lebrun (*Bull. Soc. Ing. Soudeurs*, 1934, **5**, 1326–1331).—Temperature and contraction measurements were made on mild steel plates 15 mm. (0·6 in.) thick welded by metallic arc, atomic hydrogen, and oxy-acetylene. The temperatures and distortion produced in the plates increased in that order. —H. W. G. H.

The Influence of Stresses of Thermal Origin on the Strength of Welded Structures. —— Woertmann and —— Mohr (*Schweiz. Bauzeit*, **1933**, Nov. 11; and (abstract) *Génie civil*, 1933, **103**, 363).—Parasitic stress, both parallel and perpendicular to the line of junction of the two surfaces, arises during welding. These stresses have been calculated, and their importance and means of counteracting them are discussed.—W. P. R.

Welds Under Dynamic Loading. A. J. Longoni (*Modern Eng.*, 1934, **8**, 188–193, 212–215, and 231).—The strength of a structure under dynamic loading is shown to depend on geometrical shape quite as much as, and often much more than, the strength of its members under static loading. Whilst "static strength" can be computed almost exactly from the critical cross-sectional area, the resistance to impact is governed by the elasticity of the structure, which depends on its geometrical shape and the modulus of elasticity of the material. Test values obtained from so-called "impact" tests, such as the Izod, are of little use in direct application to design, since they refer only to a specified size and shape of specimen. Resistance to occasional severe impacts can be obtained by allowing for fairly large deformation within the elastic limit, which in the case of welded structures can usually occur in the parent metal, the welds themselves contributing little to the elasticity of the structure as a whole. The case of repeated impacts and cycles of stress, however, requires attention to the fatigue-strength of weld metal and of various forms of welded joints. It is strongly emphasized that quoted figures for fatigue-strength relate to test-specimens with polished surfaces. The detrimental effect of surface conditions causing local stress accumulation and of irregular stress distribution due to faulty design, is pointed out. Cover plates and intermittent welds, for example, are undesirable for dynamic load conditions. The lower fatigue-strength usually associated with welded connections is considered to be mainly due to unfavourable geometrical shape: the welder, however, is responsible for undercutting, uneven weld surfaces, and inclusions, which are fruitful causes of failure due to stress concentration.
—H. W. G. H.

Making Dependable, Speedy, Economical Resistance Welds. Charles L. Perkins (*Welding Eng.*, 1934, **19**, (4), 30–31).—The application of copper-tungsten alloy for contact points is explained with special regard to synchronous-timed spot-welding.—H. W. G. H.

Testing of Welded Seams. Wolf von Bleichert (*Maschinenbau*, 1934, **13**, 266–267).—Brief notes on modern testing methods in practice.—K. S.

†**Testing of Welds.** G. Fiek (*Mitt. Material., Sonderheft* **25**, 1934, 23–26).—See *Met. Abs.*, this volume, p. 210.—I. M.

The Spot Welder. Some Problems of Operation and Maintenance. Vernon J. Keith (*Welding Ind.*, 1934, **2**, 245–250).—Practical hints are given on the efficient working of spot-welding machines. Faults in primary and secondary circuits, the effect of pressure on the weld, and the design and material of contact points are discussed.—H. W. G. H.

Tests of Arc Welding of Non-Ferrous Metals. Emile Ribeaucourt (*Bull. Soc. Ing. Soudeurs*, 1934, **5**, 1415–1425).—Two cases are described, in which riveted construction has given place to metallic arc welding. In the first, long seams of 7% magnesium–aluminium alloy (M.G. 7) are welded by direct current of about 8 amp., at 20–22 v./mm.^{2} of electrode cross-section. The edges of the sheets to be welded are preheated along their whole length to 330°–350° C., and are supported in a steel jig. The edges are also dented at short intervals in order to absorb the effects of longitudinal contraction. The weld is lightly hot-hammered. The second case is the repair of copper fire-boxes; here, also, the edges are preheated and are formed into undulations to reduce the effects of longitudinal contraction. The electrodes are coated with a paste containing sufficient nickel powder to introduce 0·6–0·8% nickel into the deposit.
—H. W. G. H.

From the Literature of Electric Arc and Resistance Welding. H. Le Comte (*Maschinenbau*, 1934, **13**, 384–386).—A review of recent work.—K. S.

Wear-Resistant Elkonite and Elkalloy Electrodes for Electric-Resistance Welding and Heating. K. Ruppin (*Elektrowärme*, 1934, **4**, 138–140; *C. Abs.*, 1934, **28**, 4986).—Elkonite is an alloy, with a tungsten base, which possesses very great hardness and resistance to wear. Elkaloy has a copper base and is hardened by a new process, no details of which are revealed. When used as electrodes in welding they are water-cooled and give high energy and very short current impulses. They make very good welds. Rustless steels, aluminium, brass, zinc, copper, iron, galvanized sheet, lead, nickel, silver, and gold can be welded easily; also copper to brass, brass to iron, lead to zinc, &c.—S. G.

***A New Timer for Resistance Welding.** Ralph N. Stoddard (*Elect. Eng.*, 1934, **53**, 1366–1370).—A description of a new type of timer and controller for use in the field of resistance welding of thin sheets of brass, aluminium, stainless steel, and kindred metals where a very high current is applied for a very short interval of time.—S. V. W.

Electric Resistance Welding. K. L. Nielson (*Welding Ind.*, 1933, **1**, 341–343, 372–374; 1934, **2**, 54–56, 81–83, 223–226).—The principles of resistance welding and the various methods of applying them are reviewed, their relative advantages being considered. Modern designs of resistance-welding machines are described and the technique of their use is explained. The resistance welding of steel, copper, brass, and bronze, nickel, Monel metal, and aluminium is discussed.—H. W. G. H.

From the Literature on Gas Welding. H. Le Comte (*Maschinenbau*, 1934, **13**, 268–270).—A review of recent work.—K. S.

The Revision of the Regulations for Acetylene Generators in France. Anon. (*Rev. soudure autogène*, 1934, **26**, (247), 2–4).—The new regulations divide acetylene plant into three classes, particulars of which are given.—H. W. G. H.

Note on a Volume-Meter for Acetylene. H. Gerbeaux (*Rev. soudure autogène*, 1934, **26**, (246), 8–9).—An instrument is described which is claimed to measure, with a maximum error of ± 1·3%, deliveries of acetylene from 2 to 5000 litres/hrs. The instrument is robust and its manipulation is simple.
—H. W. G. H.

XXI.—INDUSTRIAL USES AND APPLICATIONS

(Continued from pp. 527–530.)

Aluminium and Its Alloys as Substitutes for Metals of Limited Application. Anon. (*Illust. Zeit. Blechindustrie*, 1934, **63**, 1136–1137, 1170–1171).—A recent order forbids the further use in Germany of copper, nickel, and their alloys, for a variety of purposes, including roofing, guttering, casings and piping for heating and ventilation plant, washing vessels, food and drink counters, &c. A table shows Duralumin, Lautal, and Allautal as the best substitutes for structural members, and Pantal, Silumin, and the Bonn special alloy " VLW 41 " for soft brass and copper. A second table compares their physical and mechanical properties with those of copper, while a third gives the weight in kg./cm.^{2} and the area covered per 100 kg. for various thicknesses of sheet. The proper incidence of riveting, welding, and soldering is discussed, and compositions of light-alloy solders are given. The high flexibility of many light alloys makes them suitable for tube manufacture, and when finished by the Eloxal process aluminium sheet presents a hard, incorrodible, and ornamental surface suitable for restaurant work.—P. M. C. R.

Silicon–Aluminium Alloy Castings. New D.T.D. Specification. —— (*Found. Trade J.*, 1934, **51**, 322).—Abstract of material specification D.T.D. 240 for heat-treated silicon–aluminium alloy castings, covering the alloy known as " Alpha Beta."—J. H. W.

Important Metals Other than Iron. Anon. (*Metal Progress*, 1934, **26**, (4), 43–47).—An illustrated summary of the development and uses of aluminium, magnesium, nickel, copper, and zinc, and their alloys.—P. M. C. R.

Aluminium Sand or Die Castings. New [Air Ministry] Specifications. —— (*Found. Trade J.*, 1934, **51**, 191).—The four Air Ministry specifications: D.T.D. 133 B, 238, 243, and 248, relating to light alloy castings, are summarized. These alloys correspond approximately to the alloys known as Hiduminium R.R. 50, R.R. 53, R.R. 53 B (heat-treated), and R.R. 53 B (as cast), respectively.—J. H. W.

***A Study of Piston Temperatures and Their Relation to Piston Design.** H. Wright Baker (*Inst. Automobile Eng. Proc.*, 1933, **27**, 109–138; discussion, 139–144; and (abstract) *Met. Ind.* (*Lond.*), 1933, **42**, 14).—A large number of pistons, 3½ in. in diameter and of different designs, were tested by the " cooling curve " method under full-load conditions at 1640 r.p.m. Temperatures were taken at 5 points on the crown and 2 points on the skirt thrust face, and corresponding cylinder-barrel temperatures were measured at 8 points. The apparatus, test routine, and method of deducing conclusions are described. The effects of carbon deposit, small variations of clearance, mixture strength, b.h.p., and cylinder wall temperature are described. Approximately 10% of the heat received by the crown passes to the skirt from the lower edge of the ring belt in a normal aluminium piston with full circumferential union. An appreciable but undetermined proportion of this is lost to the air and oil in the crankcase. Full or partial separation increases the head temperature and lowers that of the skirt. Approximately 80% of the heat leaves such a piston *via* the ring belt. For aluminium pistons about 10% of the crown heat is given up below the head of the crankcase air and oil. Except for alloys having very high and very low conductivities, pistons of a number of light metals tested showed almost identical temperatures. Cast-iron pistons run at about the upper limit of temperature for effective working and would appear to have no advantage over aluminium with regard to " slap." For a given weight a simple, well-proportioned piston is cooler than one reinforced by ribs.—S. G.

Use of Light Alloys for the Manufacture of Solid Wheel Centres in the French Metropolitan Railways. M. G. Cros (*Recherches et Inventions*, **1933**, March; and (translation) *Aluminium Broadcast*, 1933, **4**, (5), 2–20).—J. C. C.

Fermentation without Yeast Cover with the Use of Aluminium Strips. R. Seibel (*Woch. Brau.*, 1933, **50**, 315–316; *C. Abs.*, 1934, **28**, 4168).—Dimensions and details are given of a series of aluminium strips mounted on a wooden frame. The frame floats on the surface of the vessel. The advantage of the arrangement is partly in saving labour, since it is not necessary to skim the head, and partly in preventing infection, which frequently occurs during this operation.—S. G.

Use of Aluminium in Distilleries. —— Klip (*Z. Spiritusind.*, 1933, **56**, 179–180).—A general discussion.—S. G.

Use of Aluminium Kitchen Utensils. R. Intonti (*Giorn. chim. ind. appl.*, 1934, **16**, 159–162; *Brit. Chem. Abs.*, **1934**, [B], 631).—No evidence exists of harmful effects following the use of aluminium cooking vessels.—S. G.

Biology of Aluminium.—II. H. Steudel (*Biochem. Z.*, 1932, **253**, 387–394; and (abridged translations) *Light Metals Research*, 1933, **2**, (23), 21–24; *Aluminium Broadcast*, 1933, **4**, (3), 8–11).—Analyses of the aluminium content of the liver, kidney, spleen, and heart from rats which for 4 generations were reared on foods containing much aluminium indicate that there is no increase in aluminium.—I. M.

The Use of Aluminium in the Mineral Oil Industry. C. Scalvedi (*Alluminio*, 1934, **3**, 125–128).—The use of aluminium and its alloys in the construction of tanks, apparatus, cars, refining plants, &c., is described and illustrated.
—G. G.

A System for Damping the Vibrations of Electrical Conductors. M. Preiswerk (*Alluminio*, 1934, **3**, 140–141).—Damping of the vibrations is obtained by combining with the conducting wire a hollow wire (tube) of other material having a different self-vibration frequency.—G. G.

Aluminium Alloys as Materials for Pistons. Roland Sterner-Rainer (*Z. Metallkunde*, 1934, **26**, 141–142; and *Schriften der Hessischen Hochschule, Tech. Hochschule, Darmstadt*, **1933**, (2) [typescript], 6 pp.).—Specifications for pistons for combustion engines are discussed. The properties of pistons of grey cast iron are compared with those of various aluminium alloys. Diagrams are given showing the Brinell hardness and elongation as functions of the temperature, endurance bending strength, and temperature distribution in different parts of the piston. It is concluded that pistons of light alloys, especially those of aluminium alloys with primary crystals of silicon, are superior to pistons of cast iron.—M. H.

Light Metal Coaches for Suburban Traffic. C. Wagner (*Glasers Ann.*, 1931, **109**, 100–109; *Bull. B.N.F.M.R.A.*, 1932, (40), 7).—German State Railways constructed and tested 2 electric trains in light metals (Lautal, Silumin, Skleron) for suburban service. Construction, behaviour, &c., are discussed in detail. For economic and other reasons, W. concludes that the question of the general adoption of such rolling stock must remain open.—S. G.

Aluminizing Process for Coating Telescope Mirrors. John Strong (*Phys. Rev.*, 1934, [ii], **45**, 769).—Abstract of a paper read before the American Physical Society. A steel bell jar 40 in. in diameter is evacuated by apeizon oil diffusion pumps and a Hypervac pump to 10^{-4} mm. of mercury pressure. Aluminium is distilled from 12 tungsten coils to form a uniform film $1/10\ \mu$ in thickness on the surface of the telescope mirror. The mirror surface is made clean for the coating process by an electrical discharge as the bell jar is being evacuated. The evaporated aluminium coat is immune to tarnish, adheres tenaciously to the glass, and is not easily scratched once the oxide film which forms on it is established. The reflectivity is 89% in the visible, dropping gradually to 80% at 2500 A. Measurements at Lick Observatory show that the reflectivity for photographic light exceeds that of silver by approximately 50%. Stellar spectra to 3000 A. have been obtained.—S. G.

Aluminium for Reflectors. J. D. Edwards (*Trans. Illum. Eng. Soc. (U.S.A.)*, 1934, **29**, 351–357; *C. Abs.*, 1934, **28**, 4666).—Cf. *Met. Abs.*, this volume, p. 214. Aluminium surfaces are anodically treated (details are not revealed) and the total reflectivity increased from 74 to 87% after treatment. A clear, glass-like coating is produced on the aluminium surface, which is very resistant to abrasion.—S. G.

Tests on "Alzak" Aluminium Reflectors. A. F. Dickerson (*Trans. Illum. Eng. Soc. (U.S.A.)*, 1934, **29**, 358–363; *C. Abs.*, 1934, **28**, 4666).—Cf. preceding abstract. The outstanding advantage of the new finish on aluminium is its permanence.—S. G.

The Insulator Alfol and Protection Against Fire. —— (*Rev. Aluminium*, 1934, **11**, 2549–2554).—A report of the Comité Technique de Navigation et Génie and the Office National des Recherches et Inventions, describing the results of tests on the fire-protection properties of Alfol.—J. H. W.

Effectiveness of Aluminium Priming on Wood. E. Perry (*Paint Varnish Production Manager*, 1934, **10**, (6), 5 *et seq.*; *C. Abs.*, 1934, **28**, 4611).—Commentary on Browne's studies (*Indust. and Eng. Chem.*, 1933, **25**, 835–842). Sealing of stains requires a vehicle in which the stain is insoluble. Aluminium–bronze in shellac is very effective for sealing oil stains and bitumens. —S. G.

***Covering Capacity (on Water) of Aluminium–Bronze Powder.** Junius D. Edwards and Ralph B. Mason (*Indust. and Eng. Chem. (Analyt. Edn.)*, 1934, **6**, 159–161).—A method is described for measuring the average thickness of aluminium–bronze powder flakes.—S. G.

Cadmium is Poisonous. C. R. Hazen (*Food Ind.*, 1934, **6**, 268; *C. Abs.*, 1934, **28**, 6874).—A gelatin desert allowed to solidify in a tray coated with a metal containing 56% cadmium absorbed sufficient cadmium to cause serious illness. The symptoms were severe diarrhœa, violent vomiting, and dryness of the mouth and throat.—S. G.

Purification of Inert Gas with Mischmetall. C. C. Van Voorhis, A. G. Shenstone, and E. W. Pike (*Rev. Sci. Instruments*, 1934, [N.S.], **5**, 367–368).—The purification of inert gases, already roughly cleaned, by the use of a "Mischmetall" cathode, is described. The residual ionizable impurity in neon was reduced to less than 1 part in 10^7 by the process.—J. S. G. T.

Copper, with Its Alloys, in the Petroleum Industry. L. G. E. Bignell (*Oil and Gas J.*, 1933, **32**, (25), 14; *J. Inst. Petrol. Tech.*, 1934, **20**, 36A).—Discusses the properties of copper and its alloys, and gives a table of compositions of 37 alloys of copper with various metals.—S. G.

Unsuspected Copper in Domestic Water Supplies. David W. Horn (*Amer. J. Pharm.*, 1934, **106**, 262–263; *C. Abs.*, 1934, **28**, 6887).—H. reports 2 cases in which the natural waters were free from copper but the water from the taps of the residences contained copper in excess of the drinking-water standards adopted by the U.S. Treasury Department (0·2 p.p.m.). The common feature in these 2 water supplies is the joint use of a pump that pumps both water and air and that maintains a sufficient air pressure over the water to force the water throughout the piping system of the residence, and a piping system of copper pipes. Unless the U.S. Treasury standard for copper is too stringent, it would not be prudent to use unguardedly this combination of air–water pumps and a copper pipe system.—S. G.

Copper and Brass for Heating Lines [Solders for Copper Pipe]. Carter S. Cole (*Heating and Ventilating*, 1934, **31**, (8), 37–39, 72; *C. Abs.*, 1934, **28**, 6415).—The suitability of the different grades of brass pipe for use with corrosive waters is discussed. For soldered joints with copper pipe the ordinary 50 : 50 tin–lead solder is unsatisfactory and leads to creeping; the use of 95% tin with 5% antimony gives good results. The hard solder Sil–Fos melts at about 700° C. and is satisfactory for copper tubing carrying steam pressures up to 125 lb.—S. G.

On the Materials of the Brake-Shoe in Germany. Hirosi Yamanouti (*J. Soc. Mech. Eng., Japan*, 1930, **33**, 581–594; *Mem. Fac. Sci. Eng. Waseda Univ., Tôkyô*, **1934**, (10), 61).—[In Japanese.] A pressed mixture of asbestos, iron, and brass turning scrap, and a suitable binder is superior to cast iron or bronze for making brake-shoes for railway wagons, &c.—A. R. P.

A.S.T.M. Specification for Copper–Silicon Alloys. Anon. (*Met. Ind.* (*Lond.*), 1934, **45**, 392).—Specifications B96–34T (copper–silicon alloy plates and sheets), B97–34T (sheet copper–silicon alloy), and B98–34T (copper–silicon alloy rods, bars, and shapes) of Committee B–5 on Copper and Copper Alloys, Cast and Wrought, of the American Society for Testing Materials are summarized.—J. H. W.

Minimizing Bearing Troubles with Self-Lubricating Bronze Bushings. Herbert Chase (*Machinery* (*N.Y.*), 1934, **41**, 9–12).—Porous bearings are made by pressing a mixture of 200 mesh graphite and powdered bronze containing tin 10 and copper 90% under about 20 tons/in.^{2} and heating to 805° C. for 20 minutes. Typical designs of bearings utilizing this material are described and illustrated.—J. C. C.

***Investigation on Metallic Contamination of Foods. I.—Preparation and Storage of Foodstuffs in Tinned Brass Vessels.** N. C. Datta (*Proc. Indian Acad. Sci.*, 1934, [B], **1**, 31–42).—Tinned brass vessels are readily attacked by fruit and vegetable juices and by food preparations containing large proportions of organic acids but are attacked to an insignificant degree by milk and water. Some of the alloys used in India for "tinning" brass vessels contain as much as 50% of lead. The amount of tin dissolved during storage is independent of the amount of lead present in the alloy. It is invariably largely in excess of the lead passing into solution, and apparently depends on the hydrogen-ion concentration of the stored material. Aluminium vessels are more resistant to fruit and vegetable juices than tinned brass vessels. Food prepared in tinned brass vessels containing lead affects the growth of animals adversely.—J. S. G. T.

Recent Developments in Lead Pipe for Water Services. W. Singleton (*Surveyor*, 1934, **85**, 364).—Deals with the properties of the tellurium–lead alloys; see *J. Inst. Metals*, 1933, **51**, 71.—S. G.

Defects in Cables and Their Causes. R. Gertsch (*Ann. Postes, Télég. Téléph.*, 1934, **23**, 685–694).—A summary of a report in *Bull. Tech. Administration Télég. Téléph. Suisses*, **1934**, (1). A summarized account of cable failures in Switzerland between 1927 and 1932. Defects are fully discussed, and are classified as follows: (1) those due to faulty manufacture, *i.e.* to working too cold or to the use of impure lead; (2) those caused by bad workmanship in erection; (3) those resulting from deterioration in service, *e.g.* from atmospheric discharges, overloading, or corrosion. A statistical analysis is reproduced.—P. M. C. R.

***Adhesion and Fatigue of Thin Coatings of White Metal on Mild Steel Surfaces.** (*Aeronaut. Res. Cttee. R. and M.*, No. **1424**; and (abstract) *Engineer*, 1932, **153**, 205).—Tests show that, in the best practice, the strength of the static adhesion of white metal to steel is equal to the ultimate shear stress of the white metal. Under continued alternations of stress within the fatigue limit of the steel the surface of the white metal becomes covered with a fine network of cracks, and in all cases except that of a lead–bronze, the adhesion of the liner to the steel is destroyed. Comparisons of white-metal liners, cast and centrifuged, have been made and the distribution of the constituents resulting from centrifuging has been investigated.—W. P. R.

Magnesium for Light-Weight Jigs. W. G. Harvey (*Machinist* (*Eur. Edn.*), 1934, **78**, 703).—The use of magnesium alloys in the manufacture of automobile parts is described. The higher cost of material in using these alloys is partly offset by their lower cost of machining.—J. H. W.

Magnetic Materials. I. C. Pettit (*Bell. Lab. Record*, 1934, **13**, 39–44).—A general account of the characteristics of magnetic alloys and their applications in the telephone industry. Permalloys, Perminvars, iron–cobalt alloys, and powdered Permalloy are included in this review.—J. C. C.

New Types of Linear Bolometers [Employing Thin Nickel Strip]. R. C. L. Bosworth (*Trans. Faraday Soc.*, 1934, **30**, 554–560).—Thin nickel strips prepared by electrodeposition on polished stainless steel have been employed in the construction of five types of bolometer; since the strips are much thinner than the platinum strips used in the ordinary types of bolometer the new instruments are about twice as rapid in their action.—A. R. P.

***Comparative Tests with Valve Materials in a Steam Power Plant.** G. Skript (*Z.V.d.I.*, 1934, **78**, 446).—Monel metal behaves better than red brass, cast bronze, or special bronzes in steam safety-valves.—v. G.

The Use of Tantalum in Industry. O. Kuula (*Acta Chem. Fennica*, 1934, **7A**, 41–42).—A review.—S. G.

Some Examples of the Uses of the Hard Metal Widia. A. Fehse (*Tech.-wiss. Abhandl. Osram-Konzern*, 1934, **3**, 137–139).—Information on the uses of different brands of Widia for various working materials. The working of hardened steel and glass is especially discussed. Numerous references to the literature are given.—v. G.

Zinc Sheet as a Wall Covering. Anon. (*Illust. Zeit. Blechindustrie*, 1934, **63**, 1084–1085).—The use of enamelled zinc galvanized sheet is advocated as a covering for the walls of bathrooms, dressing rooms, larders, &c., where extreme cleanliness should be combined with a pleasing appearance. Comparative tests made at the Berlin-Dahlem testing station show the superiority of enamelled zinc to stone slabs as regards resistance to corrosion by steam, moist heat, and variations of temperature. Methods of attachment are fully described.—P. M. C. R.

The Course of the Etching Process on Zinc Plates. Adolf Stiegler (*Phot. Korr. Suppt.*, 1934, 3, 15–21).—S. G.

***The Course of Total Acidity Changes and of p_H of Milk in Different Metallic Vessels.** E. Caserio (*Z. Untersuch. Lebensm.*, 1934, **67**, 587–597; *C. Abs.*, 1934, **28**, 5543).—The total acidity is always lower in vessels made of aluminium I and tinned copper than in other metals. Aluminium I acts similarly to tinned copper and is significantly better than aluminium II or tinned iron. The analyses of aluminium I and II were, respectively, copper 0·20, 0·10; iron 0·70, 0·60; manganese 0·15, 0·02; silicon 0·85, 4·30; aluminium 98·10, 94·98%. The changes in p_H are greater in vessels made of aluminium II and tinned iron than in those made of tinned copper and aluminium I. The last is as good as tinned copper and little better than aluminium II and tinned iron. The catalase number is the same for aluminium I and tinned iron, but a little higher with aluminium II and a little lower with tinned copper. The reductase number is greater with tinned copper, less with tinned iron and aluminium I, and a little less with aluminium II. There are more bacteria in tinned iron and aluminium II than in tinned copper and aluminium I. The spontaneous coagulation takes place more rapidly in aluminium I and II than in tinned iron and copper. The behaviour of aluminium with respect to the keeping of milk is as good as that of tinned copper and better than that of tinned iron if the purity of the aluminium is about 98%. When the purity of the aluminium is not below 95% the milk may be kept as well as in tinned iron. The authors assert that the greater its purity the better aluminium will serve for making such vessels.—S. G.

†The Correlation of Metallurgical and Economic Considerations in the Selection of Automobile Materials. Leslie B. Hunt (*Proc. Inst. Automobile Eng.*, 1933–1934, **28**, 66–89; discussion, 90–98).—The point of view of an engineering metallurgist as regards the specification and acceptance or rejection of a wide range of metals and alloys to withstand severe and complex stresses is presented. Among the subjects discussed are: the mechanism of failure in metals, cohesion and slip, methods of slip resistance, relative effects of various percentages of zinc, aluminium, tin, and silicon on the hardness of copper, variation of properties of aluminium–bronze with amount of second phase. The drafting of a specification based on these and other matters is suggested. Economic considerations governing the selection of suitable materials are discussed.—J. S. G. T.

Recent Metallurgical Developments and Their Significance for Shipbuilding and Marine Engineering. F. C. Lea (*Trans. N.E. Coast. Inst. Eng. Shipbuilders*, 1933–1934, **50**, 25–68; and (abstract) *Met. Ind.* (*Lond.*), 1933, **43**, 461–463).—The second Andrew Laing lecture. The paper is mainly ferrous, but the use of aluminium alloys for ship structures and in Diesel engines is briefly referred to. A *bibliography* of 48 references is appended.—I. M.

The Influence of Magnetic Fields on the Rating of Watches. A. Jacquerod and H. Mügeli (*Arch. tech. Messen*, 1934, **4**, (37), T95–T96).—The properties of the following watch-spring alloys are described, with their approximate analyses: Berrydur–copper; a similar alloy richer in beryllium; Berrydur–Contracid; Nivarox. All are non-magnetic and non-oxidizing. The portions of watches chiefly influenced by magnetizing are the compensation balance and the balance spring. Graphs show the influence of magnetization on the amplitude of vibration of the balance, and the respective effects of hysteresis, position of watch, material of casing (Mumetal, Neusilber, and stainless steel) and the degree of magnetization of spiral springs and of balances of various combinations of steel, Neusilber, Berrydur, Elinvar, Nivarox 2 and 6. Residual magnetization and the influence of the earth's magnetic field are also discussed.—P. M. C. R.

Raw Materials in Vacuum Tube Manufacture. E. R. Wagner (*Electronics*, 1934, **7**, 104–106).—The raw materials used in the construction of vacuum tubes (wireless valves) are mainly non-ferrous metals and alloys. Of these nickel and its alloys are the most important, although considerable quantities of molybdenum are used. The author discusses the use of these various metals and discusses the care that has to be used in their preparation if satisfactory results are to be obtained.—S. V. W.

Metals in Radio Apparatus. A. Mainka (*Z.V.d.I.*, 1934, **78**, 974).—A brief review of the applications of various metals in the construction of radio apparatus.—K. S.

XXII.—MISCELLANEOUS

(Continued from pp. 530–531.)

To the Memory of Professor P. P. Fedotiew. Anon. (*Metallurg* (*Metallurgist*), **1934**, (3), 3–7).—[In Russian.] An obituary notice of F., whose work in the fields of electrochemistry and electro-metallurgy of non-ferrous metals is well known.—N. A.

The Economic Importance of Non-Ferrous Metals. Victor Tafel (*Metallwirtschaft*, 1933, **12**, 360–362, 378–380, 393–394, 410–411).—Statistics on the distribution, production, consumption, and prices of the chief non-ferrous metals.—A. R. P.

The Russian Copper Industry. Rob. Heublum (*Metallwirtschaft*, 1934, **13**, 215–216).—A review of the Russian copper industry with special reference to the working of the five-year plan.—A. R. P.

Chronic Lead Poisoning. E. Smolczyk (*Gasmaske*, 1934, **6**, 30–32; *C. Abs.*, 1934, **28**, 3498).—Reference is made to data published by Neitzel (*ibid.*, 1934, **6**, 1–9) and it is shown that in Prussia alone, of all accidents due to respiratory poisoning during the year 1931, 41% were due to lead; during 1932 33% were due to lead. A suitable gas-mask is described for protection against lead dusts.—S. G.

Work of the Metallographical Commission of the Institute of Platinum and Other Noble Metals. —— (*Izvestia Platinogo Instituta* (*Ann. Inst. Platine*), **1932**, (9), 113–131).—[In Russian.] (I.—)*Investigation of Metals Produced in U.S.S.R.* Refined Russian platinum contains iridium 0·03–0·12, and iron 0·05%. The Brinell hardness (100/10), electrical conductivity, and temperature coeff. of electrical resistance for hard-worked and annealed specimens have been determined. The hardness varied as follows: hard-worked: 67·0–72·34; annealed at 700° C., 59·17–59·66, at 1000° C., 24–35·8. The sp. resistance of the hard-worked metal (ohms/c.c.) at 25° C. is 10·882–11·768 × 10^{-6}, and at 100° C. 13·797–14·893 × 10^{-6}; of annealed metal at 25° C., 11·499–11·676 × 10^{-6}, and at 100° C., 14·413–14·720 × 10^{-6}. The temperature coeff. of electrical resistance (25°–100° C.) for annealed metal is 0·00358–0·00392. Refined Russian palladium contains rhodium 0·14% and copper 0·05%. The hardness before and after annealing is 44·7 and 28·6, respectively. The sp. resistance after annealing is at 25° C. 11·011 × 10^{-6} and at 100° 13·721 × 10^{-6}. The temperature coeff. of electrical resistance (25°–100° C.) is 0·00354. (II.—) *Investigation of Alloys of Platinum and Iridium of Foreign Manufacture.* For alloys containing 2–25% of iridium the Brinell hardness, electrical resistance, and its temperature coeff., mechanical properties (tensile strength, elongation, number of bendings), and sp. gravity have been determined, both before and after annealing at 1000° C. for 36 hrs. (III.—) *Investigation of Alloys of Platinum with Copper, Palladium, and Other Metals of Foreign Manufacture.* The alloys investigated differed in composition from that given by the manufacturers. The platinum used was of "commercial" grade containing up to 0·5% of impurities. The annealed alloys have a low hardness (35–80) for easy working and are readily hardened to the requisite degree by cold-work. The influence of copper on the change in hardness and electrical resistance is considerably greater than that of palladium. Alloys of platinum and gold with less than 5% copper are very stable to acids and hydrogen sulphide.—N. A.

On Problems in the Field of Rare Metal Metallurgy [in the U.S.S.R.] During the Second Five Years [Plan]. R. L. Veller (*Redkie Metally* (*Rare Metals*), **1934**, (1), 6–9).—[In Russian.] The development of the rare metal industry and its alloys in the U.S.S.R. from 1921 to 1934 is reviewed. During this period production of tungsten, molybdenum, selenium, cobalt, boron, beryllium, chromium, tantalum, lithium, nickel, and tin has been started. The problems facing the industry are discussed.—D. N. S.

Examination of the Gold on the Masks of Mummified Bulls from the Bucheum, Amant, Upper Egypt, of the Early Ptolemaic Period. A. P. Laurie (*Tech. Studies Field Fine Arts*, 1934, **2**, 213–216; *C. Abs.*, 1934, **28**, 4002).—Qualitative tests are described which lead to the conclusion that the gold had been cemented on with egg white.—S. G.

Chemistry and Chemical Arts in Ancient Egypt.—I. L. E. Warren (*J. Chem. Education*, 1934, **11**, 146–153).—Deals with the metallurgy and uses of gold, Electrum (the composition is given), silver, copper, tin, bronze, iron, and lead.—I. M.

XXIII.—BIBLIOGRAPHY

(Continued from pp. 531–537.)

(Publications marked * may be consulted in the Library.)

***Abegg, R., Fr. Auerbach, und I. Koppel.** *Handbuch der anorganischen Chemie.* In vier Bänden. Vierter Band. Dritte Abteilung. *Die Elemente der achten Gruppe des periodischen Systems.* Zweiter Teil B: *Verbindungen des Eisens.* Roy. 8vo. Pp. xxvi + 675–875, with 198 illustrations in the text. 1935. Leipzig: S. Hirzel. (Geh., R.M. 28.)

***American Society for Testing Materials.** *Symposium on the Outdoor Weathering of Metals and Metallic Coatings.* Washington Regional Meeting, Washington, D.C., March 7, 1934. Med. 8vo. Pp. v + 113, illustrated. 1934. Philadelphia, Pa.: The Society, 260 South Broad St. (Paper, $1.25; cloth, $1.50.)

[Contains the following papers, together with the discussion that took place on them: C. D. Hocker, "Outdoor Test Results on Bare and Metal-Coated Ferrous Specimens" (see *Met. Abs.*, this vol., p. 349); R. F. Passano, "The Harmony of Outdoor Weathering Tests" (see *Met. Abs.*, this vol., p. 349); G. N. Schramm and E. S. Taylerson, "The Influence of Rainfall and Smoke on the Corrosion of Iron and Steel"; W. H. Finkeldey, "The Early Interpretation of Test Results in the Atmospheric Corrosion of Non-Ferrous Metals and Alloys" (see *Met. Abs.*, this vol., p. 350); C. L. Hippensteel, "Galvanic Corrosion by Contact of Dissimilar Metals" (see *Met. Abs.*, this vol., p. 349).]

***American Society of Mechanical Engineers.** *Mechanical Catalog and Index to Manufacturers of Industrial Equipment, Materials, and Supplies.* 1934–1935. Twenty-Fourth Annual Volume. 4to. Pp. 311. New York: American Society of Mechanical Engineers, 29 West 39th St.

Awtokratow, N. W. *Secondary Non-Ferrous Metals.* [In Russian.] Pp. ii + 109. 1934. Moscow, Leningrad, and Swerdlowsk: Metallurgisdat. (Rbl. 1.30.)

Bell, Lewis C., and **Glenn N. Shaeffer.** *Introductory Metalworking Problems.* Pp. 24. Peoria, Ill.: Manual Arts Press. (24 cents.)

Berg, Edward, and **Bristol E. Wing.** *Essentials of Metalworking.* Revised Edition. Pp. 160. 1934. Peoria, Ill.: Manual Arts Press. ($1.32.)

***British Aluminium Company, Ltd.** *Aluminium Coachwork for Passenger Vehicles.* (No. 362.) 7 in. × 9 in. Pp. 55, illustrated. 1934. London: The British Aluminium Co., Ltd., Adelaide House, King William St., E.C.4.

***British Cast Iron Research Association.** *Thirteenth Annual Report for the Year ending June 30th,* 1934. 8vo. Pp. 23. 1934. Birmingham: The Association, 21–23 St. Paul's Sq.

***Burkhardt, Arthur.** *Zink und seine Legierungen. Zusammenfassende Darstellung der Eigenschaften.* (Sonderdruck aus "Metallwirtschaft, Wissenschaft, Technik," XIII, Heft 22, 26, 28, 33, 35, und 36.) 4to. Pp. 35, with 99 illustrations. 1934. Berlin: NEM-Verlag, Schöneberger Ufer 34. (R.M. 3.40.)

[See *Met. Abs.*, this volume, p. 555.]

Chernukin, Adolph E. *The English–Russian Technical Dictionary.* Pp. 1242. 1934. New York: Amkniga Corporation. ($3.00.)

Cumming, Alex. Charles, and **Sydney Alexander Kay.** *A Text-Book of Quantitative Chemical Analysis.* Sixth Edition, revised by **Francis Clint Guthrie** and **John Trengove Nance.** Demy 8vo. Pp. xv + 482. 1934. London: Gurney and Jackson. (15*s.* net.)

***Davey, Wheeler P.** *A Study of Crystal Structure and Its Applications.* (International Series in Physics.) Med. 8vo. Pp. xi + 695, with numerous illustrations. 1934. New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd. (45*s.* net.)

***Department of Scientific and Industrial Research.** *The Industrial Application of X-Ray Crystal Analysis. Facilities Provided by the National Physical Laboratory.* Med. 8vo. Pp. 15, with 4 plates. 1934. London: Department of Scientific and Industrial Research, 16 Old Queen St., S.W.1.

Deutscher Normenausschuss. Herausgegeben vom. *Werkstoffnormen.* Stahl, Eisen, Nichteisenmetalle. Eigenschaften, Abmessgn. (DIN-Taschenbuch 4.) 8 Auflage. Pp. 164. 1934. Berlin: Beuth-Verlag. (M. 4.)

***Dews, H. C.** *The Metallurgy of Bronze.* [In Russian.] Translated into Russian by **M. P. Slavinsky** and **I. V. Gutman.** Demy 8vo. Pp. 100, with 61 illustrations. 1932. Leningrad: Zvetmetisdat. (Rbl. 2.)

***Gmelins** *Handbuch der anorganischen Chemie.* Achte völlig neubearbeitete Auflage. Herausgegeben von der Deutschen Chemischen Gesellschaft. Bearbeitet von R. J. Meyer. System-Nummer 35: *Aluminium.* Teil A.—Lieferung 2. Sup. Roy. 8vo. Pp. 285–450. 1934. Berlin: Verlag Chemie G.m.b.H. (R.M. 26; subscription price, R.M. 22.50.)

***Granjon, R.** *La soudo-brasure oxy-acétylénique des métaux et alliages.* Demy 8vo. Pp. 126, with 117 illustrations. [1934]. Paris: Office centrale de l'Acétylène et de la Soudure autogène, 32 Boulevard de la Chapelle. (10 francs.)

Henney, Keith. *Electron Tubes in Industry.* Med. 8vo. Pp. ix + 490. 1934. New York: McGraw-Hill Book Co., Inc. ($5.00); London: McGraw-Hill Publishing Co., Ltd. (30*s.*).

***Hodgman, Charles D.** Editor-in-Chief. *Handbook of Chemistry and Physics. A Ready-Reference Book of Chemical and Physical Data.* Nineteenth Edition. Fcap. 8vo. Pp. xiv + 1933. 1934. Cleveland, O.: Chemical Rubber Publishing Co. ($6.00.)

van den Hoek, A. G., en **H. J. Mathlener Loderus.** *Metalen en legeeringen. Handleiding ten behoeve van het middelbaar technisch onderwijs.* Pp. 148. 1934. Rotterdam: Nijgh & van Ditmar. (F. 3.25; bound, F. 3.90.)

***Imperial Institute.** *The Mineral Industry of the British Empire and Foreign Countries. Statistical Summary (Production, Imports and Exports) 1931–1933.* 8vo. Pp. 424. 1934. London: H.M. Stationery Office. (6*s.* net.)

***Jackson, L. C.** *Low Temperature Physics.* Post 8vo. Pp. vii + 122, with 34 illustrations. 1934. London: Methuen and Co., Ltd. (3*s.* net.)

***King, Alexander**, and **Hans Fromherz.** *German–English Chemical Terminology. An Introduction to Chemistry in English and German.* Demy 8vo. Pp. xvii + 324. 1934. London: Thomas Murby and Co. (12*s.* 6*d.* net.)

Library Association. Issued by the. *The Subject Index to Periodicals, 1933.* Roy. 4to. Pp. x + 273. 1934. London: The Library Association. (70*s.*)

Mathieu, H. *Manuel d'analyse chimique qualitative et quantitative.* Pp. 724. 1934. Paris: Masson et Cie. (60 francs; cart., 70 francs.)

***Mechanical Engineering.** *Textbook of Mechanical Engineering.* [War Office; notified in Army Orders for August, 1934.] Demy 8vo. Pp. xv + 690, with 135 illustrations. 1934. London: H.M. Stationery Office. (12*s.* net.)

***Moshage, Julius.** *Praktischer Rostschutz. Die Technik des modernen Eisenschutzes mit einer leichtverständlichen Einführung in die Theorie des Rostens.* Demy 8vo. Pp. 95, with 10 illustrations. 1934. Leipzig: Max Jänecke. (R.M. 4.)

Nitzsche, E. *Die Wärmeausdehnung der Aluminium-Gusslegierungen mit Zusatzmetallen von verschiedener Art und Menge.* 8vo. Pp. 60 + 1 plate. 1934. Würzburg: Triltsch Verlag. (R.M. 2.50.)

***Permanent Consultative Committee on Official Statistics.** *Guide to Current Official Statistics of the United Kingdom.* Volume 12: 1933. 8vo. Pp. 345. 1934. London: H.M. Stationery Office. (1*s.* net.)

***Portevin, A.** *Introduction à l'étude des traitements thermiques des produits métallurgiques.* 4to. Pp. 120, with 66 illustrations. 1934. Paris: Aciers Spéciaux, Métaux et Alliages, 4 Rue Férou. (20 francs.)

***Rimarski, W.** Herausgegeben im Auftrage des Deutschen Azetylenvereins. *Forschungsarbeiten auf dem Gebiete des Schweissens und Schneidens mittels Sauerstoff und Azetylen.* 4to. Pp. 123, illustrated. 1934. Halle a. S.: Carl Marhold. (Geh., R.M. 4.90.)

[Contains the following: E. Zorn: "Leistungswerte beim halbautomatischen und maschinellen Autogenschweissen"; H. Melhardt: "Moderne Dreiblechnahte"; W. Knoch: "Wiederherstellung beschädigter Graugusskörper durch Gasschmelzwarmschweissung"; A. Wiegand: "Herstellung geschweisster Stahlflaschen"; L. Hunsicker: "Die Anwendung der Nomographie für die Kalkulation in der Schweisstechnik"; O. Graf: "Über die Festigkeiten der Schweissverbindungen, insbesondere über die Abhängigkeit von der Gestalt"; H. Kleiner u. K. Bossert: "Einfluss der Erwärmung beim Schweissen auf die Festigkeitseigenschaften von Verbindung und Ausgangswerkstoff"; L. v. Roessler: "Spannungen in Schweissnahten"; G. Bierett u. G. Grüning: "Schrumpfspannung in autogen geschweissten Teilen"; P. Bardtke u. A. Matting:

" Eignung des Kerbschlagversuches zur Prüfung von Schweissverbindungen "; G. Fick u. A. Matting : " Eignung des Faltversuches zur Prüfung von Schweissverbindungen "; E. Kalisch u. K. Späh : " Oberflächenhärtung von Stahlwellen mittels der Azetylen–Sauerstoff–Flamme "; G. Lottner : " Das Leistungsschaubild von Azetylenapparaten "; E. Streb u. H. Kemper : " Beitrag zur Frage der Prüfung von Saugbrennern "; E. Sauerbrei : " Mischungsverhältnis und Flammenform des Saugbrenners bei schwankendem Azetylendruck im Brennerschlauch "; W. Scheruhn : " Bestimmung des Luftgehaltes in hochprozentigem Azetylen "; W. Rimarski u. L. Metz : " Explosive Eigenschaften des festen Azetylens "; W. Rimarski u. M. Konschak : " Experimentelle Untersuchungen zur Frage des Druckes in Hochdruck–Azetylenanlagen "; —— Ebel u. —— Reinhard : " Spannungsmessungen an geschweissten Rundnahten."]

Röntgen, P. *Die Metallhüttenwesen in Technik und Forschung.* (Aachener akademische Reden, Heft 1.) 8vo. Pp. 16. 1934. Aachen : Aachener Verlags- und Druck-Gesellschaft. (R.M. 0.50.)

***Standards Association of Australia.** *Australian Standard Specification for Zinc-Coated (Galvanized) Sheets (Plain and Corrugated) together with Australian Standard Methods of Determining the Weight of Coating on Zinc-Coated (Galvanized) Articles.* Part I.—*Sheets.* (No. A. 20—1934.) Fcap. [Mimeographed.] Pp. 11. 1934. Sydney, N.S.W. : The Association, Science House, Gloucester and Essex Streets. (1*s.*)

Steinberg, S. S. *Metallkunde.* Band I.—*Allgemeine Metallkunde.* [In Russian.] 2 Auflage. Pp. iv + 260. 1934. Swerdlowsk, Moscow, and Leningrad : Metallurgidsat. (Rbl. 3.40.)

***Tomashow, N. D., and J. B. Fridman.** *Heat-Conductivity of Metals and Alloys.* Part I.—*A New Apparatus for the Determination of the Heat Conductivity of Metals.* [In Russian, with English summary.] (Transactions of the Scientific Research Institute for Aircraft Materials, No. 8.) Roy. 8vo. Pp. 20, with 18 illustrations. 1934. Moscow and Leningrad : Gosmaschmetisdat. (50 k.)

***Wire.** *Lewcos Wire Tables.* Pp. 28. 1934. London : The London Electric Wire Company and Smiths, Ltd., Church Rd., Leyton, E.10. (Gratis.)

***Zimmermann, Franz.** *Kerbzähigkeit von Schweissmassen im geschweissten Werkstück im Temperaturbereich von − 195° bis + 200° C.* (Berichte aus dem Institut für Mechanische Technologie und Materialkunde der Technischen Hochschule zu Berlin. Herausgegeben von P. Riebensahm. Viertes Heft.) 8 in. × 11¼ in. Pp. 52, with 37 illustrations. 1934. Charlottenburg : Institut für Mechanische Technologie, Technische Hochschule, Berliner Str. 171–172.

NEW PERIODICALS

Industrial Heating. Vol. I, No. 1 (Oct. 1934). National Industrial Publishing Co., Union Trust Building, Pittsburgh, Pa., U.S.A. Published monthly. (Controlled free distribution on application.)

[Devoted to all industrial heating processes, furnaces, fuels, ovens, kilns, dryers, &c.]

Proceedings of the Indian Academy of Sciences. 1934, Vol. I, No. 1 (July). Monthly. Indian Academy of Sciences, Indian Institute of Science, Hebbal, Bangalore. Rs. 36 per annum; Rs. 4 or 6*s.* per issue.

XXIV.—BOOK REVIEWS

(Continued from pp. 538–544.)

National Metals Handbook. 1933 Edition. Pp. 1453, illustrated. Cleveland, O.: American Society for Steel Treating, 7016 Euclid Avenue. (Price $10.00; members, $5.00.)

Besides the usual tables of general data and articles on the general testing, working, and heat-treatment of metals nearly 700 pages are devoted to the constitution, properties, testing, melting, working, heat-treatment, welding, and surface treatments of ferrous alloys, and 451 pages to non-ferrous alloys in which numerous special articles on the constitution of particular alloy systems are contributed by acknowledged experts of the (American) Institute of Metals Division of the A.I.M.M.E. Large sections are given to tabulated data on the properties of aluminium, copper, lead, magnesium, nickel, tin, zinc, and their alloys, and brief sections to the precious metals.

This book should certainly be acquired by all workers in ferrous and non-ferrous metals, whether technical or purely scientific, since it contains a vast amount of up-to-date information which can otherwise be found only by tedious searches through the world's scientific literature. —A. R. Powell.

Gmelin's Handbuch der anorganischen Chemie. Achte völlig neu bearbeitete Auflage. Herausgegeben von der Deutschen Chemischen Gesellschaft. Bearbeitet von R. J. Meyer. System Nummer 35: **Aluminium.** Teil A—Lieferung 1. Pp. xiv + 284, illustrated. Teil A—Lieferung 2. Pp. 285–450, illustrated. 1934. Berlin: Verlag Chemie G.m.b.H. (Lief. 1, R.M. 43; subscription price, R.M. 38. Lief. 2, R.M. 26; subscription price, R.M. 22.50.)

This volume deals with the element aluminium, the metal alone being considered. The plan adopted in the preceding volumes is used in the treatment of aluminium. The history and occurrence of the element are first considered, and following this the minerals containing aluminium are dealt with very fully. The extraction and preparation of the metal are detailed together with a full description of the many methods of purification. The physical properties are next described in the order: crystallographic, mechanical, thermal, optical, magnetic, and electrical properties.

The material included in Lieferung 1 has been chosen with care and foresight; it is accurate, up to date, and well presented. The literature of the subject has been considered up to January 1934. The volume gives a readable account of the present-day knowledge of the metal aluminium, and consequently it is a most welcome addition to chemical literature. It is a book which can be confidently recommended and it must find a place in the libraries of chemical laboratories both academic and technical.

In Lieferung 2 the description of the physical properties of aluminium is continued. The first 40 pages are devoted to an account of the electrochemical behaviour of aluminium. Then comes an account of the chemical behaviour of the metal, to which about 100 pages are devoted. The behaviour of the metal with various gaseous substances, non-metals, metals, compounds of non-metals (including hydrides, oxides, halogen compounds, sulphur compounds), compounds of metals (including oxides, hydroxides, nitrates, fluorides, chlorides, perchlorates, sulphides, sulphates, borates, carbon compounds, and silicon compounds); the corrosion of aluminium in various media in relation to its purity, surface condition, and thermal treatment; its behaviour with water of various types, salt solutions, aliphatic and aromatic organic compounds, are discussed. The detection and estimation of aluminium is dealt with in the concluding section. This volume of Gmelin's handbook is a thoroughly interesting one, it is well compiled, and is written in an easy and fascinating manner. It is a book worth reading and preserving. It can be warmly recommended.—James F. Spencer.

Aluminium in Architecture. Demy 8vo. Pp. 234, illustrated. Pittsburgh, Pa.: Aluminum Company of America. ($1.00.)

This handbook is intended primarily for the builder or architect, to whom it will give an excellent description of the potentialities of aluminium and its alloys in the architectural field. The properties of recommended alloys are fully discussed, various applications are suggested and illustrated, and method of fabrication and finishing, protection, erection, and maintenance are described. Some fine photographs show the beautiful effects which have been obtained by American architects with aluminium alloys. No anxiety appears to be felt concerning the durability of their structures.—H. W. G. Hignett.

Gmelin's Handbuch der anorganischen Chemie. Achte vollig neu bearbeitete Auflage. Herausgegeben von der Deutschen Chemischen Gesellschaft. Bearbeitet von R. J. Meyer. System-Nummer 59: **Eisen.** Sup. Roy. 8vo. Teil A—Lieferung 6. Pp. 1167–1420, illustrated. Lieferung 7. Pp. 1421–1634, illustrated. 1934. Berlin: Verlag Chemie G.m.b.H. (Lief. 6, R.M. 41.50; subscription price, R.M. 36. Lief. 7, R.M. 36; subscription price, R.M. 31.50.)

The first of the two sections under review commences with an account of the general literature on alloys of iron. The systems iron–sulphur, iron–selenium, iron–tellurium, iron–boron, and iron–carbon are then discussed at length, some 67 pages being devoted to this purpose. The method of investigation of the solidification phenomena and the determination of slag inclusions in steel are described; here primary, secondary, and tertiary crystallization are considered. The various treatments of steel: hardening, cementation, heat-treatment of cementation steel, nitriding, and the nature of the products are fully described.

Lieferung 7 commences with an account of the magnetic properties of iron and steel, some 135 pages being devoted to this topic. The electrical properties are discussed at length, the remaining 61 pages of the volume being used for this purpose.

The material dealt with in the present sections of the handbook has been considered with great thoroughness, a tremendous amount of data has been gathered together and presented in a very clear and readable form. The volumes are really valuable and can be warmly recommended to chemists, physicists, and engineers.—JAMES F. SPENCER.

Die Wechselfestigkeit metallischer Werkstoffe, ihre Bestimmung und Anwendung. Von Wilfried Herold. Med. 8vo. Pp. vii + 276, with 165 illustrations. 1934. Wien: Julius Springer. (R.M. 24.)

In a work of 276 pages on fatigue in metals, many readers may expect to find chapters on the theory and operation of testing machines, but in this eminently serviceable volume scarcely a page or illustration is devoted to that aspect of the subject. Instead, the author gives a concise and very readable account of results obtained in recent research and discusses the significance of these results and their bearing on practice. The work is of special value as a link between the laboratory and practice.

Although fracture by fatigue is the main theme developed in detail, other types of fracture—tensile, notched-bar, and creep—are discussed in relation to fatigue. Separate chapters deal with fatigue in different groups of non-ferrous alloys and in steels, and later chapters refer to particular practical applications, welded and riveted joints, springs, crank-shafts, and wire-ropes.

The theoretical aspect of fatigue is discussed in detail early in the book and is kept in mind continuously in later stages as a guide to the interpretation of results. The volume is well illustrated with a number of photographs and a large number of valuable line drawings. Much data from a great variety of sources is carefully tabulated.

English readers may be dismayed to find the familiar names of many well-known investigators misspelt, and may fear that this betokens carelessness, but the work of these same investigators is with few exceptions correctly appreciated.

A serviceable bibliography is included, with name and subject indexes that are of special value in a work of this type.—B. P. HAIGH.

Thermostats and Temperature Regulating Instruments. By Roosevelt Griffiths. 8vo. Pp. v + 157, with 88 illustrations. 1934. London: Charles Griffin and Co., Ltd. (10*s.* net.)

The author has collected together an enormous amount of information not only about thermostats, but also about their adjuncts, such as relays, valves, pressure diaphragms, &c. He seems to have searched the literature of the subject very carefully, and no instrument of any importance appears to have escaped him. To follow the description of a complicated piece of apparatus is not easy at the best of times, and the author has not made it any easier by the frequency with which he seems to have " extracted " parts of a description from a catalogue or paper and presented it to the reader without all the relevant context.

Certain errors must be noted. The original design of the slow-cooling bulb in the Haughton–Hanson thermostat is quite incorrectly described. The apparatus would soon break down if used in the manner stated on pp. 10 and 11. More serious is the transposition, relative to the illustrations, of the descriptions to Fig. 64*a*, or at least the error would be serious were the illustrations and descriptions any use in explaining the mechanism illustrated. It is to be feared, however, that this is not the case.

The volume is profusely illustrated, but many of the figures could well have been omitted, as they do not in any way help in explaining the apparatus illustrated, while a protest must be made at the reproductions in Figs. 67, 69, and 70.—J. L. HAUGHTON.

Procedure Handbook of Arc Welding Design and Practice. Enlarged Edition. Med. 8vo. Pp. viii + 454, with 495 illustrations. 1934. Cleveland, O.: The Lincoln Electric Co. ($1.50.)

The first four chapters of this volume are devoted to a description of the arc-welding process in its various forms, special attention being paid to speeds and costs (for mild steel only). The only references to non-ferrous metals appear in the fifth chapter, in which the arc welding of copper, Everdur, brass, bronze, and aluminium is briefly discussed. There follow two long chapters on the design of welded steel structures and another on applications of arc welding. The book is splendidly bound, printed, and illustrated; its price is remarkably low.

—H. W. G. Hignett.

Arbeiten mit dem Schneidbrenner. Bearbeitet von Ernst Wiss. (Ausgewählte Schweisskonstruktionen, Band 6.) Herausgegeben vom Fachausschuss für Schweisstechnik im Verein deutscher Ingenieure. Format DIN A4. Pp. vi + 94. Text- u. Bildblätter mit deutschem und englischem Text. 1934. Berlin: VDI-Verlag G.m.b.H. (R.M. 9; VDI-Mitgl., R.M. 8.10.)

This " atlas " gives a thorough description of the oxy-acetylene process for cutting steel—its history, principles, economics, and applications. It is excellently produced in loose-leaf fashion: the illustrations are very fine and give striking evidence of the scope of the process.

—H. W. G. Hignett.

Die Elektronentheorie der Metalle. Von Felix Bloch. (Sonderdruck aus Handbuch der Radiologie, Band VI.) Roy. 8vo. Pp. 226–278, with 8 illustrations. 1933. Leipzig: Akademische Verlagsgesellschaft m.b.H. (R.M. 4.50.)

This little treatise on the electron theory of metals is a separate reprint of a contribution by the author to the second edition of the " Handbuch der Radiologie," Band VI, Teil 1. It reviews briefly and effectively the classical and quantical theories of electrical conduction in metals and allied subjects. The first section is devoted to a very brief statement of the classical theory, the modern statistical theory associated with the names of Pauli, Fermi, Dirac, Sommerfeld, and others who have done so much to knock away the foundations of the older structure without afterwards underpinning the building intelligibly. The second section discusses applications of the modern theory, the subjects discussed comprising the transfer of electrons across metal surfaces, the Richardson and photoelectric effects, electron diffraction, the effect of metals upon luminous and X-radiation. The third section is devoted to the interaction between conducting electrons and lattice oscillations, residual resistance, and galvanomagnetic phenomena.

An intelligent appreciation of the work demands very considerable acquaintance with modern mathematical theory. The work is essentially one for the specialist. It is authoritative in character and is unhesitatingly recommended to the very select circle of mathematical physicists.—J. S. G. Thomas.

Magnetism and Matter. By Edmund C. Stoner. Demy 8vo. Pp. xv + 575, with 87 illustrations. 1934. London: Methuen and Co., Ltd. (21*s*. net.)

This book is the successor to the author's " Magnetism and Atomic Structure " published in 1926. Its aim is to describe the magnetic properties of matter and to discuss them in terms of the modern conception of the atom. This is no easy task, for according to prevalent ideas, all is chaos on the atomic level, and the order observed in lumps of matter is supposed to be evolved therefrom by some process of spontaneous statistical averaging. The author sketches briefly the necessary mathematical theory; this is heavy going. The rest of the book deals with experimental aspects of the subject. Here Dr. Stoner's word is the word of an expert who does really possess expert knowledge of his subject. The reviewer's task in these circumstances is an easy one; he can recommend it with all the assurance shown by a *restaurateur* in recommending quails in aspic or sturgeon's roe to a gourmet. The book stands quite alone. I know no book that deals so thoroughly and completely with the theoretical and experimental aspects of the subject. It will be the standard and authoritative work on the subject for some time. Following a beautifully written historical introduction, which I commend to the notice of the general reader, come chapters devoted to classical preliminaries, experimental methods and results, the quantum theory and modern developments, diamagnetism, paramagnetism, and ferromagnetism, very strong fields, molecular magnetism, and what will perhaps appeal most to the metallurgist a very concise treatment of the magnetism of metals and alloys.

I commend the book as a whole, especially to honours students of physics; specialists will use it as a book of reference. It is provided with an extensive bibliography; there are adequate name and subject indexes; the book is well printed on very good paper and is nicely bound. Its price is very reasonable.—J. S. G. Thomas.

Handbook of Chemistry and Physics. Charles D. Hodgman, Editor-in-Chief. Nineteenth Edition. Fcap. 8vo. Pp. xiv + 1933. 1934. Cleveland, O.: Chemical Rubber Publishing Co. ($6.00.)

This very useful work of reference has, in the present edition, been made more easy to use; the book is now divided into five sections which are separated from one another by the insertion of a stiff coloured sheet between them. The sections in order contain mathematical tables, tables of properties and physical constants, general chemical tables, tables of heat, hygrometry, sound, electricity, and light, tables of quantities, and miscellaneous data.

A number of new tables have been added, including mathematical tables (27 pp.), tables of X-ray crystallographic data (43 pp.), densities of moist air (5 pp.), thermodynamic properties (14 pp.), heat of combustion of liquid fuels (½ p.), viscosity of aqueous glycerol solutions for calibration (1 p.), vapour pressure of carbon dioxide (1 p.), solubility of ammonia in water (1 p.), flame spectra (½ p.), fusibility scale (½ p.), Deming's periodic table (1 p.).

Numerous tables have been revised and enlarged, including mathematical tables (39 pp.), physical constants of minerals (18 pp.), hardness table (1 p.), specific heats of elements (3 pp.), refractive indices (13 pp.), electromotive series (3 pp.), resistance of wires (5 pp.), melting point and boiling point of elements (1 p.), mean places of stars (½ p.), viscosity of water (2 pp.), solubility of gases in water (2 pp.).

The volume is most pleasing and contains a vast amount of the most useful data. There is a good index, which is not so necessary now that the volume is sub-divided with separate contents tables at the beginning of each section.

The book may be whole-heartedly recommended to chemists, physicists, and engineers.

—JAMES F. SPENCER.

The Chemical Formulary: a Condensed Collection of Valuable, Timely, Practical Formulæ for Making Thousands of Products in all Fields of Industry. Volume I. Editor-in-Chief: H. Bennett. Demy 8vo. Pp. x + 595. 1933. Brooklyn: The Chemical Formulary Co., 950 Third Ave. ($6.00.)

As the title indicates, this book is a collection of formulæ for preparing a wide variety of chemical mixtures for use in the arts, medicine, and all kinds of industry. Among the subjects covered are adhesives, alloys, beverages, cosmetics, explosives, fluxes and solders, fuels, ink, insecticides, lacquers, metals and their treatment, oils, paper, plastics, plating, resins, and silk. The section on alloys contains a list of patented alloys apparently chosen at random and given generally without comment. Useful formulæ for many types of plating baths are given in the plating section, together with practical hints for their use. The section on metals and their treatment is almost entirely made up of abstracts of patents taken *en bloc* from one or other of the English and American abstract journals; most of the formulæ given relate entirely to steel. The section on solders and fluxes is again chiefly a collection of patented compositions. There are 51 pages of useful tables at the end of the book, followed by a 45-page index. As an afterthought the compilers have included 46 pages of formulæ for the preparation of alcoholic liquors, the separate index to which extends over more than 8 pages; this section is truly the bootlegger's *vade mecum*, even now that Prohibition is a thing of the past!

It is very difficult to appraise the true value of this book without having an opportunity to consult it in difficulties over a period of time; it does appear to the reviewer, however, that the selection of formulæ leaves much to be desired, and that in many cases the formula given will not work. This is particularly true for some of the more complicated alloy formulæ, where the proportions of the constituents are given within very wide ranges. No doubt there is a large amount of valuable information in the book, but its value is considerably reduced by the presence of so much doubtful and vague material.—A. R. POWELL.

Um die Zukunft der technischen Fachpresse. Von Kurt Schulz. Pp. 154. Berlin: VDI.-Verlag G.m.b.H. (R.M. 5.)

During the last fifty years or so the number of technical journals published throughout the world, especially in the great industrial countries, has grown enormously, so that it is difficult to keep fully abreast of modern progress in any branch of science without subscribing to a large number of journals, which in these difficult times is quite an expensive matter. From time to time efforts have been made in Germany as well as in this country to rationalize the publication of new knowledge by combining journals covering similar fields; while this has frequently been successfully accomplished, in many cases the opposite action is just as pronounced, new journals being started to deal with part of the field covered by an old journal. In this little book Dr. Schulz traces the development of the technical press in Germany from the beginning of the last century up to the present day, and indicates ways and means of curtailing the ever-present tendency to swell the lists of technical journals and of combining numbers of those now in existence into a rational scheme for the publication of progress in technical matters. If such a scheme could be put into operation the way of the humbler workers in the scientific field would be rendered easier and less expensive, and if this interesting little book assists in bringing this about the author will have earned the thanks of all such workers.—A. R. POWELL.

Kelly's Directory of the Engineering, Hardware, Metal, and Motor Trades Throughout England, Scotland, and Wales. Twenty-First Edition. 6¾ in. × 10¼ in. Pp. lvi + 2628 + 116. 1934. London: Kelly's Directories, Ltd. (45*s*. net.)

This most useful and comprehensive volume provides information regarding the trades mentioned in the title in England, Scotland, and Wales. The book is divided into two main parts. One consists of a geographical list of traders—so extensive that merely the index to the towns and places mentioned covers thirty pages of four-column printing—and the other of trades arranged in alphabetical order, followed by the names of firms and individuals engaged in these trades throughout Great Britain.

This arrangement makes it possible quickly to ascertain, for example, who are the brass founders in Birmingham—they number 199—and throughout the country where they total well over a thousand. Other trades—often much subdivided, *e.g.* "Church Plate Manufacturers" and "Chromium Plating Outfits"—are similarly classified in the "Trades" section of the directory.

To anyone having business connections with the metal industry, this specialized volume of "Kelly's" must be essential. Particularly valuable is a supplementary list of proprietary articles and trade names followed by the addresses of the manufacturers; this list alone covers 116 pages of closely printed matter.

Industrialized Russia. By Alcan Hirsch. With a Preface by Maurice Hindus. Demy 8vo. Pp. 309, with numerous illustrations. 1934. New York: The Chemical Catalog Co., Inc. ($3.00.)

Russia is veiled in mystery as deep as that surrounding the passage of Russian troops through England during the early months of the War. What really is happening in Russia to-day? About 100 books dealing with Russia are listed at the end of this volume. Some of them I have read. They leave me of the opinion that one can entertain any belief whatsoever regarding Russia, its people, and its affairs. They portray a Russia inhabited by people who may be anything between a peace-loving peasantry and unkempt murderers (you remember the war-pictures) going about with pockets filled with bombs and picking their teeth with bayonets. Dr. Hirsch has been chief consulting engineer to the Soviet Chemical Industry for some years. He writes very sympathetically of the industrialization of Russia, of the two five-year plans, and his account will be a revelation to many business men. He does not under-estimate the price that Russia is paying for her tremendous industrial achievements. To-day Russia has blast furnaces, machine shops, automobile factories, and tractor industry, and many another industry which has been developed within the last seven years or so. Dr. Hirsch tells of all these things. And not of these alone. He limns a fine picture of the whole social, administrative, industrial, religious, educational, financial, legal, and artistic organizations of U.S.S.R. The priest, the law-giver, aye and even the vamp, with the sign of her trade, as old as Chaldæa, are all here. The whole makes a very interesting fireside book. It is nicely printed and sturdily bound. A fog, characteristic, I presume, of all things Russian, seems to have descended on most of the photographic illustrations.

I commend the work to the general reader; it will interest him from beginning to end, but he will still ask "Is it all true?"—J. S. G. Thomas.

American Society for Testing Materials. Proceedings of the Thirty-Sixth Annual Meeting held at Chicago, Illinois, June 26–30, 1933. Med. 8vo. Volume 33. Part I.—**Committee Reports; New and Revised Tentative Standards; Tentative Revisions of Standards.** Pp. xii + 1092, illustrated. Part II.—**Technical Papers.** Pp. v + 804, illustrated. 1934. Philadelphia, Pa.: The Society, 260 S. Broad St. (Per Part: heavy paper, $5.50; cloth, $6.00; half-leather, $7.00.)

Part I contains the annual reports of 40 standing committees, and research and sectiona committees. Seven extensive technical papers are included with reports.

Among subjects discussed in reports of interest to the ferrous metals field are zinc coating, and iron–chromium–nickel and related alloys. In that part dealing with non-ferrous metals there are reports on corrosion, with extensive data from the results of atmospheric corrosion tests of metals exposed for one year; electrical-heating and electrical-resistance alloys, copper and copper alloys, and die-cast metals and alloys. A.S.T.M. work on methods of testing and metallography are discussed. During 1933, 47 specifications and methods of testing covering widely used engineering materials were published for the first time. All of these, together with 37 other tentative standards which were revised during 1933, are given in Part I.

All of the formal technical papers presented at the 1933 annual meeting, with the extensive oral and written discussion, are included in Part II. For convenience, papers dealing with metals appear together. Two of the technical contributions are outstanding—the lecture on

"Crystalline Structure in Relation to Failure of Metals—Especially by Fatigue," by H. J. Gough, and the Symposium on Cast Iron. Several papers discuss the development and application of tests for specific properties of metals including the torsion impact test, modified Rohn test for creep of metals, and an "overnight" test for determining endurance limit. Papers on the fatigue properties of light metals and alloys, corrosion-resistance of structural aluminium, and tests of galvanized wire under pulsating tensile stress make available very valuable information and data on these subjects. Other papers which met with much interest discuss the effect of lead additions on the hardness of tin-base bearing alloys at elevated temperatures, effect of sulphur and iron on physical properties of cast red brass, comparison of white-metal bearing alloys at elevated temperatures, and consistent data showing the influence of water velocity and time on the corrosion of iron. All of the papers of non-ferrous interest have already been abstracted in *Met. Abs.*

Final Report on the Fourth Census of Production (1930). Part II.—**The Iron and Steel Trades. The Engineering, Shipbuilding, and Vehicle Trades. The Non-Ferrous Metal Trades.** Pp. xviii + 506. 1934. London: His Majesty's Stationery Office. (7*s*. 6*d*. net.)

Tabulated data are given showing the net output, volume of production, number of establishments, size of firms, regional distribution, employment figures, wages, power and fuel consumption of firms engaged in trades enumerated in the title. Similar data are given for individual trades within the various groups. The non-ferrous metal section covers the copper and brass trade, the lead, tin, aluminium, and minor metal trades, the gold and silver refining trades, the finished brass trade, the plate and jewellery trade, and the watch and clock trade. To those interested in statistics a vast fund of interesting information on the trade of the country and the changes which have taken place therein since 1924 is contained in this volume.—A. R. POWELL.

Guide to Current Official Statistics of the United Kingdom. Volume XI: 1932. Pp. 344. 1933. Volume XII: 1933. Pp. 345. 1934. London: H.M. Stationery Office. (1*s*. net per volume.)

These are most useful classified subject indexes to government publications dealing with official current statistics, with a list of the official publications indexed.—A. R. POWELL.

Symbols and Abbreviations Used in Text.

A.	Ångström units.
abs.	absolute.
a.c.	alternating current(s).
amp.	ampère(s).
amp.-hr.	ampère-hour(s).
A.W.G.	American wire-gauge.
Bé.	Baumé.
B. & S.	Brown & Sharpe (gauge).
B.H.P.	brake horse-power.
B.O.T.	Board of Trade.
B.th.u.	British thermal units.
B.T.U.	Board of Trade unit.
B.W.G.	Birmingham wire-gauge.
C.	centigrade.
cal.	calorie(s).
c.c.	cubic centimetre(s).
cg.	centigramme(s).
c.g.s.	centimetre-gramme-second.
cm.	centimetre(s).
cm.^{3}	square centimetre(s).
cm.^{3}	cubic centimetre(s).
coeff.	coefficient(s).
const.	constant(s).
c.p.	candle-power.
C.T.U.	centigrade thermal units.
cwt.	hundredweight(s).
d	density.
d.c.	direct current(s).
dg.	decigramme(s).
diam.	diameter(s).
dm.	decimetre(s).
dm.^{2}	square decimetre(s).
dm.^{3}	cubic decimetre(s).
e.m.f.	electromotive force(s)
F.	Fahrenheit.
ft.	foot; feet.
ft.^{2}	square foot.
ft.^{3}	cubic foot.
ft.-lb.	foot-pound(s).
gall.	gallon(s).
grm.	gramme(s).
H.-F.	high-frequency.
H-ion.	hydrogen ion.
H.P.	horse-power.
H.P.-hr.	horse-power hour(s).
hr.	hour.
hrs.	hours.
in.	inch; inches.
in.^{2}	square inch.
in.^{3}	cubic inch.
in.-lb.	inch-pound(s).
I.S.W.G.	Imperial standard wire-gauge.
K.	absolute temperature (scale).
K.C.U.	kilogramme-degree-centigrade heat unit (= 3·97 B.th.u.).
kg.	kilogramme(s).
kg.m.	kilogramme-metre(s).
km.	kilometre(s).
km.^{2}	square kilometre.
kv.	kilovolt(s).
kva.	kilovolt-ampère(s).
kw.	kilowatt(s).
kw.-hr.	kilowatt-hour(s).
lb.	pound(s).
L.-F.	low-frequency.
m.	metre(s).
m.^{2}	square metre(s).
m.^{3}	cubic metre(s).
m.amp.	milliampère(s).
max.	maximum.
mg.	milligramme(s).
mm.	millimetre(s).
mm.^{2}	square millimetre(s).
mm.^{3}	cubic millimetre(s).
m.m.f.	magnetomotive force(s).
mμ	millimicron.
m.v.	millivolt(s).
N.	normal.
N.T.P.	normal temperature and pressure.
oz.	ounce(s).
P.C.E.	pyrometric cone equivalent.
p.d.	potential difference.
p.p.m.	parts per million.
R.	Réaumur.
r.p.m.	revolutions per minute.
sp. gr.	specific gravity.
sq.	square.
v.	volt(s).
va.	volt-ampère(s).
w.	watt(s).
w.-hr.	watt-hour(s).
w.p.c.	watts per candle.
$^\circ$	degree(s) (arc or temperature).
%	per cent.
λ	wave-length.
μ	micron.
$\mu\mu$	1 millionth micron = 0·1 A.
Ω	ohm.
$'$	minute of the arc.
$''$	second of the arc.
$<$	$A < B$ denotes that A is less than B.
$>$	$A > B$ denotes that A is greater than B.
$\nless$	negative of $<$; $A \nless B$ denotes that A is not less than B.
$\leq$	combination of $<$ and $=$; $A \leq B$ denotes that A is equal to or less than B.
$\neq$	is not equal to.
$\equiv$	identically equal to.
$\cong$	approximately (or essentially) equal to.