METALLURGICAL ABSTRACTS

(GENERAL AND NON-FERROUS)

1932 JULY Part 7

I.—PROPERTIES OF METALS

(Continued from pp. 337–346.)

Tensile Strength and Electrical Conductivity of Pure Aluminium and Aluminium Conductor Alloys as Affected by Mechanical and Thermal Treatment. H. Bohner (*Aluminium Applications*, 1930, 2, (5)).—Abstracted from *Hauszeit. V.A.W. u.d. Erftwerk A.G. Aluminium*, 1929, 1, 12–30. See *J.*, this volume, p. 294.—J. C. C.

The Existence of Small Quantities of Gases and Oxides in Aluminium and Aluminium Alloys: Their Determination and Removal. R. Sterner-Rainer (*Light Metals Research*, 1931, 1, (19), 2–12; discussion, 1931, 1, (20), 21–29).—A translation from *Z. Metallkunde*, 1931, 23, 274. See *J.*, this volume, p. 209.
—J. C. C.

X-Ray Studies on Bismuth Single Crystals. A. Goetz and R. C. Hergenrother (*Phys. Rev.*, 1932, [ii], 40, 137–150).—X-ray analysis has been used to compare bismuth crystals grown in a transverse magnetic field (cf. Goetz and Focke, *Phys. Rev.*, 1930, [ii], 37, 1044; see this *J.*, 1931, 47, 465) with those grown under ordinary conditions. The (111) interplanar spacing was determined as 3·9453 ± 0·0002 A. (at 23°); and no difference existed between the two types of crystals. The parameter along (111) was 0·359 ± 0·0006 A., and again no difference existed between the two types of crystals. The conclusion is that growth in a magnetic field affects the secondary mosaic structure of the crystals, and not the lattice itself. The change in mosaic structure then influences the density, electrical resistance, thermal e.m.f., &c. A new photographic recording method is described for measuring intensities of X-ray reflections, and the results are in agreement with those of the highly sensitive ionization method of Hergenrother (*Physics*, 1932, 2, 211–216).
—W. H.-R.

Anomalous Diamagnetism of Bismuth. S. Ramachandra Rao (*Nature*, 1932, 129, 545–546).—The decrease of diamagnetic susceptibility of bismuth with increasing degree of subdivision is shown to be a genuine effect.—E. S. H.

The Sorption of Gases by Copper. Arthur F. Benton and T. A. White (*J. Amer. Chem. Soc.*, 1932, 54, 1373–1390).—The procedure consisted in admitting a known volume of gas to an evacuated bulb containing the adsorbent, noting the change of pressure with time, and adding further gas until equilibrium pressures of approximately one atmosphere were reached. The reverse process was also used. Measurements were made on reduced copper, with nitrogen, hydrogen, and carbon monoxide gases. Three processes were found to occur: (*a*) surface physical adsorption, (*b*) surface activated adsorption, and (*c*) solution. Nitrogen showed only physical adsorption, whilst hydrogen and carbon monoxide showed all three processes. The amounts of hydrogen taken up in each process were determined.—R. G.

On Certain Variations in the Optical Constants of Copper. H. Lowery and R. L. Moore (*Phil. Mag.*, 1932, [vii], 13, 938–952).—A brief survey of the methods of determining the optical constants is given, and discrepancies between the results of various observers using polarimetric methods for determining optical constants are discussed. It is suggested that the Beilby theory of polish may explain these discrepancies, and this suggestion is tested by measuring the optical constants of copper for λ 5770 A., using varying degrees of surface strain of the metal. A heavy polish is found to increase the

refractive index and to decrease the absorption and reflexion coeffs. This agrees with Margenau's results for silver, but there is an apparent difference from Drude's and Tate's results. Some experiments carried out on the rate of deterioration of a copper mirror suggest the most satisfactory condition for measurement of the dispersion curve.—J. S. G. T.

Hafnium. Anon. (*Indust. Australian*, 1931, **86**, 394).—An account is given of the sources, distribution, and properties of this metal and its compounds, together with their commercial applications, which are already considerable in the case of electrical and radio apparatus.—P. M. C. R.

The Exact Measurement of the Specific Heats of Iridium and Ruthenium between 0° and 1604° C. F. M. Jaeger and E. Rosenbohm (*Proc. K. Akad. Wet. Amsterdam*, 1931, **34**, 808–822).—[In English.] Values for the specific heats of iridium and ruthenium are given for the temperature range indicated. The results for ruthenium indicate allotropic changes. At least four such transitions occur when the temperature is raised. The first transformation ($\alpha \rightleftharpoons \beta$) occurs at 1030°–1040° C.; the accompanying heat absorption is only small and amounts to about 0·69 cal. per grm. at 1035° C. The second transformation ($\beta \rightleftharpoons \gamma$) takes place slightly below 1200° C., and the third ($\gamma \rightleftharpoons \delta$) at about 1500° C. The results are compared with those obtained for other elements in Group VIII of the Periodic Table, from which it appears that with increasing complexity of atomic structure there is a decreased tendency for allotropic transformations to occur, which lead to the existence of separate phases.—E. S. H.

Measurements of the Thermo-Electric Forces of Lead and Tin Down to the Temperature of Liquid Helium. W. H. Keesom, C. H. Johansson, and J. O. Linde (*Proc. K. Akad. Wet. Amsterdam*, 1931, **34**, 1365–1371).—[In English.] Cf. *J.*, this volume, p. 339. Thermo-electric forces have been measured against a standard silver alloy wire for lead down to 1·7° K. and for tin down to 4·8° K. The value for the couple superconducting lead/silver alloy is small and that for lead/tin (both in the superconducting state) is zero. For both metals there is a rapid change in de/dT and hence in the Thomson heat at the temperature where the metals become superconducting. The conclusion is reached that the Thomson effect at the critical temperature falls rapidly from finite values to zero.—E. S. H.

On the Resistance of Lead and Tin to High-Frequency Currents at Superconducting Temperatures. J. C. McLennan (*Trans. Roy. Soc. Canada*, 1931, **25**, III, 191–193).—Superconductivity is observed in tin and lead when a high-frequency a.c. ($1{\cdot}1 \times 10^7$ per second) is employed instead of d.c., but the transition temperature is lowered. The depression is greater as the frequency is increased.—E. S. H.

Lithium. Frhr. von Girsewald (*Metallgesellschaft Periodic Rev.*, 1929, (2), 13–19).—[In English.] The industrial recovery of lithium salts from the ores is attended with special difficulties, but it was very greatly stimulated by the discovery in 1918 that small percentages of the metal when added to aluminium caused a considerable increase in hardness. At first the lithium fluoride was produced by breaking down lepidolite with sulphuric acid and precipitating with sodium fluoride. Later research led to the selection of potassium sulphate as the best decomposing agent. Ultimately lithium chloride is produced and is electrolyzed in the molten state to give the metal. Lithium is mainly used as a hardener in alloys with other metals—*e.g.* in lead for bearing metals which are now extensively used on the German railways, and in aluminium (Skleron). The preparation of pure lithium salts for medicinal purposes needs exceptional care. Lithium hydroxide is now added to alkaline accumulators containing cadmium.—W. A. C. N.

Physical Properties of Lithium Vapour. A. Bogros (*Ann. Physique*, 1932, [10], **17**, 199–282).—A method has been developed for determining very small

vapour pressures by means of the atomic jet; it is based on Knudsen's effusion method, from which it differs principally in that two orifices are used. The method has been employed for measuring the saturated vapour pressure of lithium in the temperature interval 459°–572° C. The results conform to the equation $\log_{10} p = -A/T + B$, where p is the vapour pressure, T the absolute temperature, $A = 6110$, and $B = 5{\cdot}39$. The calculated latent heat of evaporation is 4027 grm.-cal. per grm. Variations of the composition of the vapour which issues through the jets, and of the residual metal, demonstrate the existence of two isotopes. Spectroscopic study of atomic jets of lithium, and particularly of the structure of the resonance line at 6708 A., confirms the existence of isotopes of atomic weights 6 and 7.—H. F. G.

Magnesium: Growth of an American Industry. John A. Gann (*Metal Progress*, 1932, **21**, (4), 33–38, 84).—From an address before the Institute of Metals Division, American Institute of Mining and Metallurgical Engineers, February 1932.—P. M. C. R.

The Hall Effect in Solid Mercury. James T. Serduke and Thomas F. Fisher (*Phys. Rev.*, 1932, [ii], **39**, 831–834).—Using fields up to 19 kilogauss, the Hall effect has been measured in solid mercury at − 60° C. with specimens 14 cm. long by 2 cm. wide, and with thicknesses from 0·006 to 0·09 cm. The average value of the Hall constant R is − 0·000788, with an error of ± 10 per cent., and is independent of field strength, current density, and thickness of the specimen. This is much larger than the value found by Fenniger (*Phil. Mag.*, 1914, **27**, 109). The longitudinal change in resistance was too small to be measured.—W. H.-R.

The Glow Discharge in Pure Mercury Vapour. Fritz Koppen (*Z. Physik*, 1932, **75**, 654).—An investigation of electrical characteristics of the glow discharge in pure mercury vapour employing cathodes of aluminium, nickel, iron, silver, tungsten, copper, mercury, molybdenum, and carbon respectively, is described.—J. S. G. T.

An Attempt to Activate Adsorbed Mercury Atoms by Ultra-Violet Light. L. H. Reyerson (*Physics*, 1932, **2**, 70–72).—Mercury atoms adsorbed on catalytically-active copper atoms are not activated by the light from a mercury vapour lamp sufficiently to cause reaction between hydrogen and ethylene. Mercury vapour under similar conditions does cause such an action to occur.

—J. S. G. T.

The Modulus of Torsion of Nickel at High Temperatures and under Simultaneous Magnetization. Willy Möbius (*Physikal. Z.*, 1932, **33**, 411–417).—The change in the elastic properties of ferromagnetic crystals at the Curie point, to which attention has been directed by London, is confirmed in the case of a nickel wire. The value of the modulus, determined in a longitudinal magnetic field, passes, with increase of temperature, first through a minimum, then through a maximum. The elastic properties of ferromagnetic materials in the region of the Curie point are associated with magnetostriction phenomena, and are not to be explained by a removal of the coupling between valency forces.

—J. S. G. T.

On the Effect of Magnetization on the Modulus of Elasticity of Ferromagnetic Rods [Nickel]. E. Giebe and E. Blechschmidt (*Wiss. Abhandl. Physikal.-Tech. Reichsanstalt*, 1932, **15**, 291–322).—Reprint from *Ann. Physik*, 1931, [5], **11**, 905–936; see *J.*, this volume, p. 147.—M. H.

The Electrical Conductivity of Ruthenium, Ruthenium Carbide, and Tungsten Carbide. J. C. McLennan, J. F. Allen, and J. O. Wilhelm (*Trans. Roy. Soc. Canada*, 1931, **25**, III, 13–17).—A previous report that ruthenium becomes superconducting at very low temperatures (*ibid.*, 1929, **23**, III, 283; *Nature*, 1929, **123**, Feb. 1) is modified. Pure ruthenium does not become superconducting, and the previous results were due to the presence, as an impurity, of tungsten carbide which becomes superconducting at 2·05° K.—E. S. H.

Some Thermal Properties of Tantalum. C. L. Utterback and L. A. Sanderman (*Phys. Rev.*, 1932, [ii], **39**, 1008–1011).—The total radiation from tantalum was measured from 1000° K. to 2200° K. and is represented by an equation of the type $E = cT^n$, where $n = 4{\cdot}72$, in contrast to the work of Worthing (*Phys. Rev.*, 1926, [ii], **28**, 190), which gave $n = 4{\cdot}80$. A spectral temperature scale, $\lambda = 0{\cdot}667\ \mu$, is given up to 2100° K. From 1000° K. to 2600° K. the electrical resistance is represented fairly well by the equation $R_T = R_{1000}\,[1 + \alpha\,(T - 1000)]$, where $\alpha = 81{\cdot}5 \times 10^{-5}$. The thermal e.m.f. against platinum is given by the equation $\log_{10} E = A \log_{10} t + B$, where $A = 2{\cdot}06$, $B = -2{\cdot}16$, and E is in microvolts, and t in ° C. These determinations were for the range 19°–419° C.—W. H.-R.

The Cry of Tin. Bruce Chalmers (*Nature*, 1932, **129**, 650–651).—The "cry" of tin is not peculiar to that metal, but has been obtained also from single-crystal specimens of cadmium and zinc. It appears to be an accompaniment of twinning in both the polycrystalline and single crystalline states. A "cry" has not been obtained from metals crystallizing in the cubic system.—E. H.

The Cry of Tin. E. N. da C. Andrade (*Nature*, 1932, **129**, 651).—Cf. preceding abstract. The sound probably indicates that twinning is propagated from layer to layer with a velocity of the order of that of sound. Possibly the phenomenon exists in other cases, but the frequency may be too high for audibility.—E. S. H.

Evaporation of Platinum in Vacuum from a Tungsten Filament. John Strong (*Phys. Rev.*, 1932, [ii], **39**, 1012–1013).—A note. If platinum is deposited electrolytically on to a tungsten filament, it can readily be evaporated by sending a current through the filament, and mirrors, interferometer plates, &c., can be coated with platinum with less trouble and better results than by sputtering. A citric acid plating solution at about 100° C. is satisfactory. Attempts to evaporate platinum by laying a small piece in a tungsten coiled filament were unsuccessful owing to inefficient heating.—W. H.-R.

Determination of Poisson's Number μ of Rolled Zinc Sheets. H. Siegler-schmidt (*Z. Metallkunde*, 1932, **24**, 55–56).—A continuation of the work of Schmid and Wassermann on the anisotropy of zinc sheets (cf. this *J.*, 1931, **47**, 261). Poisson's ratio for zinc sheet (2·3 mm. in thickness) is 0·299 in the direction of rolling and 0·226 in the transverse direction. The moduli of elasticity are 8200 and 10,100, respectively. The accuracy of the measurements was confirmed by tests on steel.—M. H.

The Shape of Growth of Metal Crystals. G. Tammann and K. L. Dreyer (*Z. anorg. Chem.*, 1932, **205**, 77–80).—In the separation of primary copper crystals from molten copper–bismuth alloys, silver crystals from molten silver–lead alloys, and zinc crystals from molten zinc–tin, zinc–lead, and zinc–cadmium alloys, the edges of the crystals are the more rounded the higher is the crystallization temperature and the slower the rate of cooling (even with relatively low liquidus temperature). This rounding is caused by shrinkage of the crystals by surface tension.—M. H.

On the Influence of Small Quantities of Impurities in Metals (with Discussion). W. Fraenkel (*Light Metals Research*, 1931, **1**, (20), 12–29).—Translated from *Z. Metallkunde*, 1931, **23**, 221–224. See *J.*, this volume, p. 4.—J. C. C.

Some Physical Concepts in Theories of Plastic Flow. R. L. Peek, Jr., and D. A. McLean (*J. Rheology*, 1931, **2**, (4), 370–384).—A mathematical theory of the slow deformation of soft solids under steady state conditions in capillary tubes is developed.—J. S. G. T.

Fundamental Equations and Definitions concerning the Mechanics of Isotropic Continua. K. Hohenemser and W. Prager (*J. Rheology*, 1932, **3**, (1), 16–22).—Equations of deformation of material are developed and applied to discuss the essential qualities of "ideal" materials, fluid, solid, plastic, and viscous.—J. S. G. T.

On the Question of the Fatigue of Metals. W. Kuntze (*Light Metals Research*, 1931, **1**, (22), 8–12).—Translated from *Metallwirtschaft*, 1931, **10**, 895. See *J.*, this volume, p. 149.—J. C. C.

More Rational Strength Calculation. E. Lehr (*Metallurgist* (Suppt. to *Engineer*), 1932, **8**, 39–41).—A summary of a paper in *Z.V.d.I.*, 1931, **75**, 1473. See *J.*, this volume, p. 150.—R. G.

Polish on Metals. R. C. French (*Nature*, 1932, **129**, 169–170).—The method of electron diffraction has been used to investigate the nature of the surface layer of polished metals. The polishing of copper or silver with emery, using benzene as lubricant, caused diffuse diffraction rings to appear in place of the usual sharp rings, but the same atomic spacings were obtained, indicating that the size of the original crystals is decreased by the treatment. Polishing with light magnesium oxide and water caused only two broad diffraction rings to appear, indicating a spacing of copper atoms different from that in the crystal structure. Similar broad rings appeared in stainless steel polished with rouge and water. It is considered that the atoms of metal in the polished surface have a semi-orderly arrangement and that Beilby's view of the formation of the vitreous layer is substantiated.—E. S. H.

Polish on Metals. J. T. Randall and H. P. Rooksby (*Nature*, 1932, **129**, 280–281).—The electron diffraction investigation of polished metal surfaces (cf. preceding abstract) tends to show that with increasing degree of polishing the crystal breaks down into smaller units, the interplanar spacings eventually being altered. At the same time, a certain amount of truly amorphous material may be produced. This tends to fog the diffraction pattern, so that the weaker bands become indistinct or invisible.—E. S. H.

Polish on Metals. F. Kirchner (*Nature*, 1932, **129**, 545).—The observations described in the two preceding abstracts are interpreted in the following way: a polycrystalline metal surface under bombardment by electrons at a grazing angle gives sharp diffraction rings if the surface consists of small lumps which are thin enough to allow the electrons to pass through. These lumps act as a grating, but they are levelled by polishing. The sharpness of the diffraction rings may prove nothing, therefore, about the real size of the crystals, but may give information about the degree of levelling of the surface. —E. S. H.

Polish on Metals. C. A. Murison, N. Stuart, and G. P. Thomson (*Nature*, 1932, **129**, 545).—Cf. preceding abstracts. Surfaces of platinum sputtered on to glass have been examined by the electron diffraction method and are found to give different diffraction patterns, one of which corresponds with that of massive platinum. Platinum sputtered in an atmosphere of oxygen at a voltage not exceeding 1150 is an active catalyst for the hydrogen–oxygen combination and gives at first diffuse rings similar to those observed in polished metals. After the metal has been used as a catalyst, or after it has been heated in a vacuum, it loses its catalytic activity and again gives the sharp diffraction rings characteristic of ordinary platinum. It is probable that the diffuse rings are due to material in a very finely divided condition rather than to flatness of the platinum surface (cf. preceding abstract).—E. S. H.

Electronic Energy Levels of the Elements with Special Reference to their Connexion with the Sizes and Electronic States of Atoms in Metallic Crystals. W. Hume-Rothery (*Phil. Mag.*, 1932, [vii], **13**, 196–197).—Errors in one of the diagrams accompanying the previous paper by H.-R. (*Phil. Mag.*, 1931, [vii], **11**, 671; this *J.*, 1931, **47**, 278) on this subject are corrected.—J. S. G. T.

The Hume-Rothery Relationship between the Ionization Potentials of the Elements and their Atomic Number. H. Yagoda (*Phil. Mag.*, 1932, [vii], **13**, 1163–1171).—H.-R. has shown, from considerations of inter-atomic distances in crystals that n^2V is approximately a linear function of $Z^{2/3}$, n denoting the total quantum of the outermost shell of electrons of an element of atomic

number Z, and V the element's ionization potential. (See *Phil. Mag.*, 1930, [vii], **10**, 217.) For neutral atoms this theorem is shown to be essentially correct; a better correlation of the properties of the members of a specific group of the periodic classification is, however, given by $\log n^2V = a \log Z + b$, in which a approaches the value 2/3 throughout the classification and b is a constant for each group. In the case of singly-ionized atoms, the values of a deviate more from the theoretical limit than in the case of neutral atoms.—J. S. G. T.

Anomalies Exhibited by Cathode-Sputtering. Cl. Munster (*Z. Physik*, 1932, **75**, 716–722).—Within the geometrical region of the shadow of a quartz fibre cast by the discharge from a heated silver cathode, the deposit of silver produced by cathodic sputtering from a silver cathode shows three regions of maximum deposit, which are not present when the deposit is produced by purely thermal evaporation.—J. S. G. T.

The Thermal Conductivities of Certain Approximately Pure Metals at High Temperatures. L. C. Bailey (*Z. Metallkunde*, 1932, **24**, 94).—Abstracted from *Proc. Roy. Soc.*, 1931, [A], **134**, 57–76; see *J.*, this volume, p. 4.—M. H.

Measurements on Thermo-Electric Forces down to Temperatures Obtainable with Liquid or Solid Hydrogen. G. Borelius, W. H. Keesom, C. H. Johansson, and J. O. Linde (*Proc. K. Akad. Wet. Amsterdam*, 1932, **35**, 15–24).—[In English.] Measurements of thermo-electric force against a standard silver alloy are given down to the temperatures obtained with liquid or solid hydrogen for silver, silver–gold alloy, and gold alloys containing small quantities of iron, cobalt, nickel, manganese, chromium, and titanium, respectively.—E. S. H.

Measurements on Thermo-Electric Forces down to Temperatures Obtainable with Liquid Helium. G. Borelius, W. H. Keesom, C. H. Johansson, and J. O. Linde (*Proc. K. Akad. Wet. Amsterdam*, 1932, **35**, 25–33).—[In English.] Thermo-electric forces have been measured down to the temperatures of liquid helium for platinum and for alloys of copper with small amounts of iron against a standard silver alloy. In the case of the copper–iron alloys the thermo-electric force per degree near the absolute zero is proportional to the absolute temperature. With rising temperature the value passes through a maximum and then decreases. With increasing concentration of iron the maximum is displaced towards higher temperatures. As a sensitive thermo-element for the temperature range of liquid hydrogen and liquid helium the authors recommend the combination: gold containing about 1 atom-% of cobalt against silver containing about 1 atom-% of gold.—E. S. H.

Additional Experimental Verification of Fowler's Photoelectric Theory. George B. Welch (*Phys. Rev.*, 1932, [ii], **40**, 470–471).—A note. Previous work (*Phys. Rev.*, 1928, [ii], **32**, 657) showed that with metal surfaces prepared in a vacuum without thorough outgassing, the photoelectric currents changed with time after the surfaces had been filed. The data are shown to agree with Fowler's theory (*Phys. Rev.*, 1931, [ii], **38**, 45) which indicates that the work function increases slightly with time, except for germanium which shows a decrease. Data are given for calcium, iron, cobalt, nickel, copper, zinc, and germanium.—W. H.-R.

Theory of the Change of Electrical Resistance of Metals produced by Hydrostatic Pressure. Kôtarô Honda, Tamotu Nishina, and Tokutarô Hirone (*Z. Physik*, 1932, **76**, 80–90).—The change of resistance of metals produced by hydrostatic pressure is explained in terms of the Höjendahl–Frenkel theory of free electrons, which is based on the Thomas–Fermi theory of electronic distribution about the atomic nucleus. Data relating to cæsium, lithium, bismuth, antimony, calcium, copper, gold, aluminium, lead, nickel, sodium, magnesium, potassium, iron, cobalt, zinc, rubidium, strontium, molybdenum, palladium, silver, cadmium, tantalum, tungsten, platinum, and thallium, are tabulated. Satisfactory agreement is found, in general, between experimental and theoretical results. It is anticipated that in the case of all metals, the

resistance of which initially decreases with increase of hydrostatic pressure, a minimum value of the resistance will be attained at a sufficiently high pressure.
—J. S. G. T.

On the Dilatation of Superconductors. J. C. McLennan, J. F. Allen, and J. O. Wilhelm (*Trans. Roy. Soc. Canada*, 1931, **25**, Sect. III, 1–12).—A study has been made of the thermal and magnetic dilatation of lead and Rose's metal in the neighbourhood of the temperatures obtainable with liquid helium. No discontinuity was observed in the thermal expansion curve for lead, and it appears that when the superconducting point is passed there is no sudden change in the crystal lattice of the metal to correspond with the appearance of superconductivity. The thermal expansion curve is almost horizontal below the transition point, suggesting that the effect of heat agitation on the lattice structure must be small in this region. The magnetic field necessary to restore the electrical resistance produces no change in length of the specimen. It is concluded that the phenomenon of superconductivity is not entirely dependent on the relative spacing of the atoms in the solid lattice.—E. S. H.

The Phenomena of Superconductivity with Alternating Currents of High Frequency. J. C. McLennan, A. C. Burton, A. Pitt, and J. O. Wilhelm (*Proc. Roy. Soc.*, 1932, [A], **136**, 52–76).—Currents of frequency $1{\cdot}1 \times 10^7$ per second in a coil of lead wire indicated a considerable and abrupt decrease of resistance of the wire at a temperature slightly lower than the critical temperature (7·2° abs.) characteristic of the incidence of superconduction with d.c. With tin wire, employing d.c., the resistance decreased abruptly at 3·76° abs. and disappeared completely at 3·70° abs.; the corresponding temperatures in the case of a.c. of frequency $1{\cdot}1 \times 10^7$ per second were 3·67° abs. and 3·61° abs. Similar results were obtained with tantalum wires. The depression of the transition temperature when a.c. are employed appears to be a function of the current frequency in the metal; it is not attributable to a skin effect. It is concluded that polarization and orientation phenomena are involved in the production of the superconducting state in metals. The superconducting state is analogous in some respects to the saturated magnetic state in ferromagnetic metals.—J. S. G. T.

A New Kind of E.M.F. and other Effects Thermodynamically connected with the Four Transverse Effects. P. W. Bridgeman (*Phys. Rev.*, 1932, [ii], **39**, 702–715).—The Hall effect is examined thermodynamically, and it is concluded that if the Hall e.m.f. has a temperature coeff., there should be a reversible heating effect when a transverse current flows across a conductor carrying a longitudinal current in a magnetic field. This could not be detected experimentally, and other arguments show that it should vanish. The conclusion is that a new kind of e.m.f. must exist in a conductor carrying a current in which the temperature is uniformly changing. Similar investigations are made for the other thermo-magnetic and galvano-magnetic effects, and their interdependence is discussed. Experiment shows that with metals like bismuth internal non-isotropic effects, due to the unequal resistance of crystals in different directions, may be large enough to introduce errors in the measurement of the Ettinghausen coeff. It is concluded that the specific heat of a conductor is altered by the presence of an electric or thermal current, and a consideration of magnitude shows that the velocity associated with the thermal current is that of sound in accordance with the Debye theory.
—W. H.-R.

Thermomagnetic E.M.F.'s in Transversely and Longitudinally Magnetized Wires. Roland Schaffert (*Phys. Rev.*, 1932, [ii], **39**, 1017–1018).—A note. Criticism by Heaps (*Phys. Rev.*, 1931, [ii], **38**, 1391; *J.*, this volume, p. 73) showed that, in the work of Ross (*Phys. Rev.*, 1931, [ii], **38**, 179–181; this *J.*, 1931, **47**, 643), in addition to the thermo-junctions formed by the transversely and longitudinally magnetized parts of the wire, there will be junctions of

magnetized and unmagnetized material where the two long ends of the wire leave the magnet. Three junctions will be at different temperatures owing to conduction of heat along the wires. Experiments with iron, nickel, and Permalloy are described and show that these additional effects may be considerable. When no magnetic field is present there is an e.m.f. owing to the Thomson effect in the wire, and this must be subtracted in order to obtain the purely thermomagnetic effect.—W. H.-R.

II.—PROPERTIES OF ALLOYS

(Continued from pp. 346–354.)

On Aluminium–Antimony Alloys. J. Veszelka (*Mitt. berg. Hüttenmänn. Abt. königl. ungar. Hochschule Berg-, Forstwesen, Sopron, Ungarn*, **1931**, **193**–201; *Chem. Zentr.*, 1932, **103**, I., 2230).—The system contains only one compound, AlSb, melting at 1080° C. and one eutectic at 1·2% aluminium. In alloys with 1·2–18·4% aluminium AlSb appears as primary crystals in a eutectiferous ground-mass and in alloys with 18·4–99% aluminium as primary crystals in an aluminium-rich ground-mass of unknown composition. The compound decomposes in moist air with the formation of aluminium hydroxide. —A. R. P.

Effect of Temperature on the Physical and Casting Properties of No. 12 Aluminium Alloy. George H. Starmann (*Met. Ind.* (*N.Y.*), 1932, **30**, 181–182). —The aluminium alloy tested contained 7·32% copper, 1·06% zinc, 1% iron, and 1·62% silicon. Casting above 1300° F. (705° C.) results in a reduction of the tensile strength, hardness, and impact strength. Soaking at a high temperature has a similar action, but if the metal is cooled to 1260–1300° F. (680°–705° C.) before casting, the effect is not nearly so marked.—A. R. P.

The Influence of Cold-Rolling on the Age-Hardening of Duralumin. K. L. Meissner (*Z. Metallkunde*, 1932, **24**, 88–89).—To ascertain the influence of different degrees of reduction by cold-rolling on the age-hardening of Duralumin the yield point, tensile strength, and elongation were determined (*a*) after quenching, ageing for 5 days, and subsequent reduction in thickness (2–50%), and (*b*) after quenching, immediate cold-rolling, and subsequent ageing. Results show that the yield point and tensile strength are considerably reduced after treatment (*b*), the reduction being greater the more severe the rolling, *e.g.* the tensile strength after treatment (*a*) is 45 or 49 kg./mm.^{2}, after reductions of 10% or 30% and after treatment (*b*) 40 or 42·5 kg./mm.^{2}. The elongation is practically the same after both treatments for a given reduction. The influence on the age-hardening process of cold-rolling between quenching and ageing, however, becomes practically negligible if the rolling is done not immediately after quenching but only after ageing for 4–6 hrs.—M. H.

The Influence of Temperature on the Notch Toughness of Aluminium Alloys. Torao Kobayashi (*Mem. Ryojun Coll. Eng.*, 1930, **3**, 145–153; and (abstract) *Light Metals Research*, 1931, **1**, (11), 24; *C. Abs.*, 1931, **25**, 1477).—[In German.] Duralumin, "Y" alloy, and other commercial aluminium alloys were worked, quenched, and aged for 20 days, after which test-pieces were placed in an impact machine and tested at temperature intervals of 50° C. up to 550° C. The heating arrangement was attached to the testing machine and could be removed simultaneously with the release of the pendulum. The notch toughness was found to resemble plasticity, in that it increased with increasing temperature, reaching a maximum at 450° C.—S. G.

Investigation of Duralplat Sheets. K. Schraivogel and Erich K. O. Schmidt (*Z. Metallkunde*, 1932, **24**, 57–62).—Duralplat is Duralumin sheet plated with an age-hardenable aluminium alloy without copper which has a higher corrosion resistance than Duralumin. Results of tensile, bending, and Erichsen tests of Duralplat 0·8, 1·5, 2·0, and 4·0 mm. in thickness are tabulated. Dural-

plat has a modulus of elasticity of 7000–7300 kg./mm.^{2}, an elastic limit (0·02% elongation) of 19·7–22·7 kg./mm.^{2}, a yield-point (0·2% elongation) of 23·7–30·1, a mean tensile strength of 39 kg./mm.^{2} (against 38–42 kg./mm.^{2} for Duralumin), and an elongation of 18%. The bending capacity of Duralplat is practically the same and the Erichsen number a little smaller than that of unplated Duralumin. The protective coating adheres very well. The behaviour of Duralplat and Duralumin sheet in the oxidizing salt test (1 month), in the salt spray test (9·5 months), and in sea-water (5·5 months) was tested by the determination of the change in the surface appearance, tensile strength, elongation, and microstructure. In all cases corrosion of Duralplat took place solely on the protective coating and its tensile properties remained unchanged, whereas the elongation of Duralumin considerably decreased. In contact with Duralumin rivets the coating is somewhat corroded, but the head itself is only slightly attacked. Riveted Duralumin is strongly corroded.—M. H.

Foundry Alloy A.P. 33. J. Suhr (*Rev. Aluminium*, 1932, **9**, 1669–1680).—"A.P. 33" is an aluminium alloy containing copper 4·5, titanium 0·45%, and a minimum of silicon and iron. Its elastic limit is 22–25 kg./mm.^{2}, yield-point 30–35 kg./mm.^{2}, and elongation 5–8%. A microscopic study of the alloy showed that the best results from the point of view of mechanical strength are obtained with a structure corresponding with a regular mass of the compound $CuAl_2$ in which the titanium is distributed as evenly as possible. Other things being equal as regards composition and heat-treatment, this structure depends on the conditions of manufacture and the pouring. The effects of bad pouring conditions will not be remedied by subsequent heat-treatment. The effect of titanium is to refine the grain-size of the alloy, and this effect increases up to 0·4% titanium; more than this amount has a deleterious effect on the mechanical properties of the alloy. Small quantities of iron have a negligible effect on the strength and hardness of the cast alloy. Up to 0·4% iron has an appreciable effect on the efficiency of the heat-treatment and rapidly lowers the tensile strength and hardness of the heat-treated alloy to the level of the cast metal.—J. H. W.

Chlumin, A New Aluminium Alloy. I. Iitaka (*Light Metals Research*, 1931, **1**, (18), 11).—An abstract from *Proc. Imp. Acad. Tokyo*, 1931, **7**, 161. See *J.*, this volume, p. 11.—J. C. C.

[**Lithium–Aluminium Alloy.**] Anon. (*Machinery* (*Lond.*), 1930, **37**, 172).—Very brief note of a lithium–aluminium alloy said to be almost as strong as steel and capable of withstanding long and heavy wear, *e.g.*, in bearings.
—H. F. G.

[**Aluminium Alloy.**] Anon. (*Machinery* (*Lond.*), 1930, **37**, 44).—Very brief note of an alloy said to be used in France in the construction of hydrophones; it is a casting alloy containing 13% of silicon, and just before pouring 1–2% of sodium is added. The tensile strength is 30,000–35,000 lb./in.^{2}, and elongation 7–15%. The alloy has very fine grain, is easily welded, and is highly resistant to corrosion, especially by sea-water; it is a little lighter than aluminium.—H. F. G.

Thermal and Electrical Conductivity of Light Metals. W. Mannchen (*Light Metals Research*, 1931, **1**, (15), 3–7).—Translated from *Z. Metallkunde*, 1931, **23**, 193. See *J.*, this volume, p. 10.—J. C. C.

Solid Solutions of Lead and Tin in Bismuth. Eric R. Jette and Frank Foote (*Phys. Rev.*, 1932, [ii], **39**, 1018–1020).—A note. Alloys of bismuth with 1% and 10% of lead and tin respectively, were prepared and annealed, and the lattice constants determined by the X-ray analysis of annealed filings. In each case a slight solid solution is formed, and results in an increase in the *c* axis, and a decrease in the *a* axis, so that the anisotropy of the crystal increases. Since tin and lead have respectively smaller and larger atomic radii than bismuth, their similar behaviour is surprising.—W. H.-R.

Density and Hardness of Copper-Rich Alloys. G. Krebs (*Z. ges. Giesserei-Praxis: Das Metall*, 1932, **53**, 186).—A discussion of the density, hardness, and strength of copper-rich alloys of the order copper 95, tin 5%.—J. H. W.

Metals for the Engineer—"Aluminium-Bronze." F. C. Thompson (*Manchester Guardian Commercial*, **1931**, July 9; and *Light Metals Research*, 1931, **1**, (15), 8–11).—A general review of properties and uses.—J. C. C.

Beryllium Adds Strength to Copper. J. Kent Smith (*Iron Age*, 1932, **129**, 767).—Short abstract of a paper entitled: "Copper–Beryllium 'Bronzes,'" read before the American Institute of Mining and Metallurgical Engineers. See *J.*, this volume, p. 224.—J. H. W.

Ordinary and Special Bronzes. Leon Guillet (*Cuivre et Laiton*, 1932, **5**, (75), 127–128).—A brief study of the copper–tin equilibrium diagram and a discussion of the commercially useful bronzes.—W. A. C. N.

A Study of Melting Plugs for Boilers. K. B. Thews and R. W. Snelling (*Wärme*, 1930, **53**, 975–979; *C. Abs.*, 1931, **25**, 5315).—Of 100 used plugs examined by the U.S. Bureau of Standards, the filling had melted in 47 on the fire side of the boiler, it had been forced out on the fire side by expansion in 11, it had oxidized through half the thickness on the fire side in 10, and it had been forced out on the water side to a considerable extent in 7 and had been corroded on the water side. The following general rules are given regarding their construction: diameter of the filling on the fire side 12 mm. (9 mm. for very high pressures), diameter on the water side 3 mm. more than on the fire side, diameter in the centre larger than that at either end; optimum composition of the shell = copper 87, tin 10, zinc 2, lead 1%; before pouring the filling, heat to 250°–275° C., wash with hydrochloric acid, and then pour the tin at 275°–300° C. The tin should be as pure as possible—99·75% tin, and not more than 0·05% zinc and 0·02% lead. Impurities have a negligible effect on the variation of the melting point ($\pm$ 2° for 0·5% impurities), but the resistance to corrosion is decreased by the presence of zinc (electrochemical action sets in with as little as 0·1%), which is offset by the presence of lead (0·05–0·1%). A working life of 1 year (with margin of safety) can thus be obtained. It is recommended to use 2 sets of plugs, with a joint life of 2 years, each set alternating every 2 months and being examined when not in use. The life is reduced if the water contains an excess of sodium carbonate or calcium carbonate and, to a less extent, if the fuel contains sulphur.—S. G.

The Influence of Third Metals on the Constitution of Brass Alloys. IV.—The Influence of Aluminium. A Contribution to the Knowledge of the Ternary System Copper–Zinc–Aluminium.—II. O. Bauer and M. Hansen (*Z. Metallkunde*, 1932, **24**, 73–78).—Cf. *J.*, this volume, p. 225. The constitution of the copper–zinc–aluminium alloys with 50–100% copper and 0–10% aluminium, has been studied by thermal analysis and micrographical investigation of six sections through the ternary model with a constant aluminium content of 1, 2, 4, 6, 7·7, and 9·4%. (1) The solidification and constitution of the copper-rich ternary alloys are chiefly determined by the isomorphism of the α, β, and γ solid solutions in the copper–zinc and copper–aluminium systems. The solidification is analogous to that of the binary copper–zinc and copper–aluminium series of alloys, in that within a certain range of concentration the peritectic reactions α + melt $\rightleftharpoons$ β and β + melt $\rightleftharpoons$ γ take place. The temperatures of the peritectic reactions in the copper–zinc system (905° and 833° C.) are raised with increasing aluminium content towards the corresponding temperatures in the copper–aluminium system (1031° and 1017° C.). In addition to the three one-phase fields α, β, and γ and the two-phase fields ($\alpha + \beta$) and ($\beta + \gamma$), which extend through the whole system, there is a two-phase field ($\alpha + \gamma$) and also a three-phase field ($\alpha + \beta + \gamma$) which extends from the ($\alpha + \gamma$) field of the copper–aluminium system to alloys with zinc contents of 16–24, and 30%, respectively. (2) Numerous diagrams of vertical

and horizontal sections are given showing the transformations and changes in solubility taking place in the solid state. The ternary β solid solution decomposes with fall in temperature with the separation of at first either ternary α- or ternary γ-crystals and—when the aluminium exceeds 3·5%—at temperatures below 537° C. of α and γ simultaneously. Within a certain concentration range β disappears completely, *i.e.* the reaction β ⟶ eutectoid (α + γ) takes place. (3) The limits of the saturated α and β-phases are displaced by additions of aluminium to higher copper concentrations. With more than 3·5–4·25% aluminium (according to the copper content), the brittle γ constituent exists, in addition to α + β in alloys containing 72·5–65·5% copper. The compositions of the α-, β-, and γ-phases in equilibrium at 410° C. are: α = copper 72·5, aluminium 3·5, zinc 24%; β = copper 65·5, aluminium 4·25, zinc 30·25%; γ = copper 71·5, aluminium 11·5, zinc 17%.
—M. H.

The Influence of Third Metals on the Constitution of Brass Alloys. IV.—The Influence of Aluminium. A Contribution to the Knowledge of the Ternary System Copper–Zinc–Aluminium.—III. O. Bauer and M. Hansen (*Z. Metallkunde*, 1932, **24**, 104–106).—Cf. *J.*, this volume, p. 225, and preceding abstract. The microstructure and colour of aluminium-brasses after various heat-treatments are described, figures for the Brinell hardness of annealed and subsequently slowly cooled alloys are tabulated, and the results of the whole investigation are summarized.—M. H.

Factors Affecting the Physical Properties of Cast Red Brass (85 Cu, 5 Zn, 5 Sn, 5 Pb). H. B. Gardner and C. M. Saeger, Jr. (*Amer. Soc. Test. Mat. Preprint*, **1932**, June, 1–18).—An investigation was sponsored by the Non-Ferrous Ingot Metal Institute at the U.S. Bureau of Standards to collect data on which to base further work on bringing about agreement on an optimum number of typical compositions of copper-base ingot metals. In the present paper all work has been restricted to the alloy having the nominal composition 85% copper, and 5% each of zinc, tin, and lead. Four distinct types of test-bars were cast at each of 5 pouring temperatures, 1040°, 1095°, 1150°, 1205°, and 1260° C. Tensile strength, Brinell hardness, electrical resistivity, and density were determined on each bar and the results compared. These results permitted the grouping of the different test-bars into 3 classes: (1) the bars from the chill ingot; (2) ingots obtained by the "immersed crucible" method; (3) the sand-cast bars. Only slight variations were found between the values obtained for test-bars of virgin metal and corresponding bars made of remelted metal. The shrinkage and the running qualities of the alloy were determined for the alloy made from both virgin metal and remelted metal. The metallographic structure of the bars poured at the higher pouring temperatures leads to the conclusion that, in general, marked columnar structure is accompanied by inferior physical properties. Pronounced non-uniformity of structure was found in one type of sand-cast test bar. Microscopic examination tended to show that sand-cast test bars poured at high temperatures were subject to high tensile cooling stresses and had inferior physical properties. It was noted that an expansion of the alloy occurred immediately following solidification.—S. G.

Some Causes of the Staining of Strip Brass in Process. Charles K. Skinner (*Met. Ind.* (*N.Y.*), 1932, **30**, 140–142).—Staining may be due to annealing in an oxidizing atmosphere, to the use of too hot or too concentrated a pickling solution, to too tight coiling during pickling or to washing in impure water.
—A. R. P.

Season-Cracking of Brass. F. Ostermann (*Anz. Berg-, Hütten-u. Masch.*, 1931, **53**, (97), 4–5). Cf. this *J.*, 1931, **47**, 430. The theory of season-cracking of copper–zinc alloys is discussed and some examples of cracking in weighing dishes, cups, and tubes are described.—B. Bl.

Brass, Bronze, and Copper Alloys. W. R. Hibbard (*Met. Ind.* (*Lond.*), 1932, **40**, 242, 261–262).—Reproduced from *Amer. Metal Market.* Slightly condensed from a paper read at a Conference on Metals and Alloys under the auspices of the Cleveland Engineering Society and the Case School of Applied Science. An account is given of the composition and type of copper alloys used for bearings and bushings, refrigerators and aircraft, for building purposes, die-pressing, and hand-forgings. Copper is not recommended for use at high temperatures, as it begins to anneal at 150° C. and to oxidize at 400° C. At red heat, it is penetrated by hydrogen, becoming brittle, and brass gradually loses zinc at temperatures above 450° C. These disadvantages do not apply to Avialite, an alloy containing copper 89–91, aluminium 9–11, nickel etc. not more than 1·5%, and used for valve seats in aircraft engines. Everdur, an alloy containing approximately copper 96, silicon 3, and manganese 1%, is recommended for use as nails, bolts, and screws.—J. H. W.

Doehler Brass Die-Castings [Brastil]. Anon. (*Automotive Ind.*, 1932, **66**, 142).—Brastil, a brass die-casting alloy, is claimed to possess tensile strength 40–42 tons/in.^{2}, elongation 10–17% on 2 in. Brinell hardness with 3000-kg. load 160–180, sp. gr. about 9·3. High corrosion-resistance, good machining, and bearing properties, a high casting finish, and an appearance similar to "white gold" are claimed for the alloy.—P. M. C. R.

P.M.G. Metal Hardener. Anon. (*Machinery* (*Lond.*), 1930, **37**, 143–145). —An account of "P.M.G." alloy, developed by Vickers Armstrong, Ltd. It is composed of copper, iron, and silicon, and is intended to replace tin in all copper alloys. The alloy is simple to prepare and is much cheaper than tin, and it greatly improves the physical and mechanical properties of alloys in which it is incorporated. Details of working such alloys are given, with results of tests on forged and cast alloys as compared with brass, aluminium bronze, and Admiralty gun-metal.—H. F. G.

The System Gold–Mercury. I. N. Plaksin (*Z. Metallkunde*, 1932, **24**, 56, 89).—Abstracted from *Trudi daljnjewostotschnowo gossudarstwjennowo uniwerssiteta*, series VII, No. 13, *Wladiwostok* 1929, see also this *J.*, 1928, **39**, 498; 1929, **41**, 459; **42**, 457. Earlier investigations on the constitution of gold amalgams are briefly reviewed. The equilibrium diagram by P. is reproduced and described.—M. H.

The Superconductivity of Alloys containing Gold and Silver. J. C. McLennan, J. F. Allen, and J. O. Wilhelm (*Phil. Mag.*, 1932, [vii], **13**, 1196–1209).—Ag–Sn (eutectic) is found to become superconducting at about 0·2° below that (3·72° K.) at which tin becomes superconducting. Ag_3Sn–Sn (eutectic) is superconducting at a slightly higher temperature than AgSn. Ag_3Sn was not found to be superconducting, although a considerable drop of resistance occurred at 3·6° K. Ag_3Sn + 3% Sn shows some of the features attributable to its constituents and becomes superconducting at about 2·30° K. $AuSn_4$–Sn (eutectic) is superconducting at about 3·52° K. $AuSn_4$ becomes superconducting at 2·4° K., $AuSn_2$–$AuSn_4$ (eutectic) at 3·125° K., $AuSn_2$ at 2·48° K. AuSn and AuSn–Au (eutectic) did not exhibit superconduction. $AuPb_2$–Pb (eutectic) is superconducting at 7·0° K., $AuPb_2$ at 6·9° K., Au_2Pb–$AuPb_2$ (eutectic) at 7·0° K., and Au_2Pb at 3·59° K. In alloys with superconducting elements, gold and silver produce an effect on the transition temperature which is opposite to that produced by bismuth, antimony, and arsenic. These latter generally raise the transition temperature; gold and silver produce a pronounced depression. A binary alloy system of one super-conductor and one non-superconductor does not necessarily have a unique transition temperature. Superconduction appears at higher temperatures in eutectic alloys than in compounds of the same metals. In the mixed structure of an eutectic there must exist forces of most considerable magnitude which cause superconductivity to appear at temperatures other than would be anticipated.—J. T.

Arsenic in Ternary Lead-Base Bearing Alloys. K. H. Wegner (*Metals and Alloys*, 1932, **3**, 116–119).—Addition of arsenic to lead-base bearing alloys results in a uniform structure containing regularly distributed needle-shaped crystals having an arsenic-rich core consisting of a ternary solid solution of arsenic, antimony, and tin. The interlocking of the needles permits of the production of a uniform alloy under variable melting and casting conditions. The presence of arsenic inhibits the formation of cubes of the tin–antimony constituent which have such a pronounced tendency to segregate as shown by the following table, which gives the composition of alloys solidified in the iron crucible in which they were melted:

Alloy.		Arsenic, %.	Antimony, %.	Tin, %.	Lead, %.	Brinell Hardness.
A	Top of ingot .	1·69	15·13	11·0	72·18	24·9
	Bottom of ingot.	1·54	15·06	10·78	72·62	24·9
B	Top of ingot .	0·13	18·57	13·44	67·86	29·7
	Bottom of ingot.	0·09	11·47	8·40	80·04	21·0

—A. R. P.

Mechanical Properties of White Metal Bearing Alloys at Different Temperatures. H. K. Herschman and J. L. Basil (*Amer. Soc. Test. Mat. Preprint*, **1932**, June, 1–20).—A study was made of the wear-resistance and other mechanical properties of 10 white-metal bearing alloys. These included 2 tin-base and 7 lead-base alloys and 1 cadmium–zinc alloy. Each of the properties, with the exception of wear, was determined at several temperatures, ranging from 20° to 200° C. Resistance to wear was determined only at 20° C. No one of the alloys tested was found to excel in all of the mechanical properties studied. Thus, the tin-base alloys showed higher resistance to wear and in most cases had higher Izod impact values at each temperature of test than the lead-base alloys, but in most cases showed lower resistance to pounding than the lead-base and cadmium–zinc alloys. The hardness numbers and compressive properties of the tin-base alloys were found to be lower than those for the alkaline-earth metal hardened lead and the cadmium–zinc alloys. The mechanical properties of the lead–antimony–tin alloys were, in most cases, higher as the tin content was increased. Crankshaft bearings of 4 compositions were prepared for service tests in U.S. Army class B trucks. These compositions consisted of 2 tin-base and 2 lead-base alloys. The results of these tests indicated that the tin-base alloys were superior in their wear resistance to the lead-base alloys. These results were consistent with those obtained on wear in the laboratory tests.—S. G.

The Constitution of Copper–Magnesium Alloys Rich in Magnesium. F. De Carli (*Metallurgia italiana*, 1931, **23**, 18–21; *C. Abs.*, 1931, **25**, 5381).—The limit of solubility of copper in magnesium has been determined by measuring the conductivity of rods of alloys of varying composition. Definite minima are shown with alloys containing 0·1% copper, which is, therefore, the limit of solubility of copper in magnesium.—S. G.

Magnesium as a Structural Metal. Anon. (*Metallurgia*, 1932, **6**, 6).—A brief description of the uses of magnesium as a deoxidizer in the field of nickel and nickel–alloy metallurgy; as an essential constituent of alloys of aluminium and of zinc and in the development of high strength structural alloys containing magnesium and 2–8% aluminium, and 0·15–0·4 manganese. Such alloys when manufactured on a commercial scale have a high ratio of fatigue endurance to weight, and are free from intercrystalline corrosion. Special alloys have also been developed for their high thermal conductivity, and others for their resistance to salt-water corrosion.—J. W. D.

Technology and Applications of Elektron Metal. Walther Schmidt (*Z. Elektrochem.*, 1931, **37**, 508–517; discussion, 517).—Abstract of a paper read before the Deutschen Bunsen-Gesellschaft fur angewandte physikalische Chemie. See *J.*, this volume, p. 17.—J. H. W.

Effect of Cold-Working on the Izod Notched-Bar Impact Value of Monel Metal. N. B. Pilling (*Amer. Soc. Test. Mat. Preprint*, 1932, June, 1–8).—The notched-bar Izod value of Monel metal is first increased and then decreased by cold-working. The maximum occurs at about 10% reduction by cold-work, corresponding with a Brinell hardness in the range 155–175. Stress relief annealing increases both the hardness and impact value. Impact properties of drawn rods are sensibly uniform and do not depend on the relative direction of bending. Impact properties of rolled flats are highly directional and depend on the position of the notch with respect to the axes of rolling. Impact value is greatest when the notch lies parallel to the breadth dimension of the flat. The correlation between hardness and Izod value is good only when working is followed by a low-temperature anneal. In these circumstances the Izod value is closely related to the apparent Brinell hardness of the fibre parallel to the bottom of the notch.—S. G.

Monel Metal. N. C. Marples (*Nickel Bulletin*, 1932, **5**, 97–104).—The mechanical properties of Monel metal are tabulated and the manner in which this alloy meets the requirements of high mechanical strength, resistance to corrosion, retention of strength at superheated steam temperatures, surface appearance, freedom from rusting, and ease of cleaning, is described. The applications of the alloy are discussed, and the machining, grinding, annealing, spinning, pressing, and methods of jointing by silver soldering, brazing, and oxy-acetylene welding are described.—J. H. W.

Ferromagnetism and Phase Configuration in the Binary System Nickel–Manganese. Seiji Kaya and A. Kussmann (*Wiss. Abhandl. Physikal.-Tech. Reichsanstalt*, 1932, **15**, 213–229).—Reprint from *Z. Physik*, 1931, **72**, 293–309; see *J.*, this volume, p. 20.—M. H.

Hot Structural Hardening of Iron–Nickel–Tungsten Alloys. A. Portevin, E. Prétet, and H. Jolivet (*Compt. rend.*, 1932, **194**, 1237–1239).—The general phenomenon of structural hardening of alloys by precipitation has hitherto been used to improve certain cold mechanical properties. If, however, the alloy is chosen so that the thermal zone of fine precipitation corresponds exactly with the required temperature, an increase in strength (résistance) at that temperature results. This has been observed with iron–nickel–tungsten alloys, even in the absence of carbon. When the tungsten exceeds a certain value, depending on the temperature and the nickel content (and ultimately on that of other elements as carbon and silicon), certain constituents appear in the γ-solid solution or austenite, corresponding with the definite compounds observed in the iron–tungsten alloys by various authors. A study of the solubility of these constituents in the austenite was made by dilatometric analysis and by micrography after annealing at various temperatures. The rate of precipitation, measured against the cold hardness varied with the temperature (shown by curves for the alloy containing nickel 30, tungsten 25%). Measurements of the strength at high temperatures show that maintaining the alloy at elevated temperatures causes a continued diminution of the strength by coalescence. Similar phenomena are observed when molybdenum is substituted for tungsten.—J. H. W.

Researches on the Constitution of the Systems Silver–Antimony–Zinc, Silver–Cadmium–Antimony, and Silver–Copper–Antimony. A Contribution to the Basis for New Silver Alloys. W. Guertler and W. Rosenthal (*Z. Metallkunde*, 1932, **24**, 7–10, 30–34).—The phase equilibria at about 400° C. and lower temperatures in these ternary systems have been partly cleared up by the use of Guertler's "Klärkreuz" method by means of microscopical

investigation of a large number of alloys. Results are shown in a number of ternary diagrams (for which the original must be consulted) with typical photomicrographs. Some details of the binary systems silver–antimony and copper–antimony are included.—M. H.

The Affinity of Metals to Sulphur. II.—Thermal Dissociation Equilibria of the Sulphides of Silver, Copper, and Arsenic. E. V. Britzke and A. F. Kapustinsky (*Z. anorg. Chem.*, 1932, **205**, 95–112).—Cf. this *J.*, 1931, **47**, 80. Former investigations of the thermal equilibrium between hydrogen and silver sulphide (Ag_2S) at 912–1067° C. have been revised by a new direct method.—M. H.

Alloys of Zinc and Manganese. N. Parravano and V. Montoro (*Metallurgia italiana*, 1930, **22**, 1043–1051).—See this *J.*, 1931, **47**, 378.—S. G.

Tensile Properties of Rods and Wires at Low Temperatures. F. Pester (*Z. Metallkunde*, 1932, **24**, 67–70, 115–120).—(1) The tensile strength of rolled rods (20 mm. in diam.) of copper, bronze (99·5% copper, 0·5% magnesium), aluminium, Aldrey, and steel (0·34% carbon) increases linearly with decreasing temperature between + 20° and — 77° C. by about 21%, 18%, 14·9%, 17%, and 17·3%, respectively. With fall in temperature the elongation of all materials increases to some extent and the reduction in area decreases slightly with copper, bronze, and steel and remains practically constant with aluminium and Aldrey. (2) For the results of tensile tests and bending tests of wires at low temperatures see this *J.*, 1930, **44**, 469–470. (3) The bending capacity of wires has been redetermined at room-temperature, — 20°, and — 60° C. by means of a new alternating bending machine (described in detail). The bending number increases with decreasing temperature for copper, bronze, and aluminium, remains constant for Aldrey, and reaches a maximum for steel wire at — 20° C.—M. H.

Salt-Like Compounds and Intermetallic Phases of Sodium in Liquid Ammonia. E. Zintl, J. Goubeau, and W. Dullenkopf (*Z. physikal. Chem.*, 1931, [A], **154**, 1–46).—A solution of sodium in liquid ammonia reacts with the halides of sulphur, selenium, tellurium–arsenic, antimony, bismuth–tin, lead–thallium–zinc, cadmium, mercury–copper, silver, and gold to give a range of compounds which form a transition group between salts and intermetallic phases. The compounds of sodium with sulphur, selenium, tellurium, arsenic, antimony, bismuth, tin, and lead are salts similar to the polyhalides and polysulphides. With thallium, zinc, cadmium, mercury, copper, silver and gold, on the other hand sodium forms insoluble metallic phases with atomic lattices free from ammonia.—B. Bl.

Polyplumbides, Polystannides, and their Transition to Metallic Phases. E. Zintl and A. Harder (*Z. physikal. Chem.*, 1931, [A], **154**, 47–91).—Extraction of sodium–lead or sodium–tin alloys with liquid ammonia affords ammonosols of the amines of sodium enneaplumbide Na_4Pb_9 or sodium enneastannide Na_4Sn_9 containing the "polyanions" $[Pb_9]''''$ or $[Sn_9]''''$. Evaporation leaves the amorphous amines which on removal of the ammonia are converted into metallic phases identical with those in melted alloys of the same composition. The structures of the metallic phases of the sodium–lead system and their formation have been investigated by X-rays. Pure lead forms solid solutions with sodium having $a = 4{\cdot}932$ A. The β phase extends from 28 to 32 atomic-% sodium and has a cubic lattice ($a = 4{\cdot}873$ A.) with 4 atoms in the elementary cell; it contains neither Na_2Pb_9 nor Na_4Pb_5. The sodium atoms have the position 000, the lead atoms the positions $0\frac{1}{2}\frac{1}{2}$, $\frac{1}{2}0\frac{1}{2}$ and $\frac{1}{2}\frac{1}{2}0$. If lead completely fills these points in the cell, this would correspond with the compound $NaPb_3$. But as the β phase always contains more than 25 atomic-% sodium some of the lead atoms are irregularly replaced by sodium. The linear contraction of the β lattice at the formation of mixed crystals is 4%. Evidence is adduced to show that the alloys of the alkali metals cannot be considered as complex compounds, and methods are described for preparing

sodium–lead and sodium–tin alloys with a clean surface and of a definite composition and for their analysis.—B.Bl.

On the Preparation of Debye–Scherrer–Diagrams of Alloys Sensitive to Air. E. Zintl, A. Harder, and S. Neumayr (*Z. physikal. Chem.*, 1931, [A], **154**, 92–96).—A method of powdering, tempering and drawing off for oxidizable and hygroscopic substances with exclusion of air. (See preceding abstract.)—B.Bl.

Pewter and its Manufacture. B. Egeberg (*Brass World*, 1931, **27**, 177–179).—Abstract from *Monthly Rev. Amer. Electroplater's Soc.*, 1931, **18**, (6), 34–42). See *J.*, this volume, p. 22.—J. H. W.

Zinc Alloys for High- and Low-Temperature Service. H. A. Anderson (*Bell Telephone System Tech. Publ. Monograph*, **B-652**, 1932, 1–19).—Reprint from the A.S.T.M. and A.S.M.E. Symposition on Effect of Temperature on the Properties of Metals, see this *J.*, 1931, **47**, 431.—S. G.

Influence of Recrystallization Temperature and Grain-Size on the Creep Characteristics of Non-Ferrous Alloys. C. L. Clark and A. E. White (*Amer. Soc. Test. Mat. Preprint*, 1932, June, 1–15).—Presents the results of long-time creep tests conducted on alloys of the copper–zinc, copper–tin–zinc, and nickel–copper series, at temperatures both above and below their lowest recrystallization temperature. Certain of the materials investigated were of identical chemical composition, but varied in grain-size. The results indicate the creep characteristics to be greatly influenced by the recrystallization temperature and by the grain-size. It is shown that not only is there a sharp decrease in a metal's ability to resist creep as the recrystallization temperature is passed, but also there is a change in the nature of the creep characteristics. At temperatures below this temperature, metals are able to resist stresses of appreciable magnitude without measurable continuous creep, whilst at temperatures above, appreciable continuous creep occurs under the stresses used with a probability that continuous creep would occur at any stress. Grain-size and recrystallization temperature have been found to be so related that at temperatures below the lowest recrystallization temperature, fine-grained materials offer the greatest creep resistance, whilst at temperatures above, the coarse-grained material is superior. These findings support the hypotheses previously advanced by C. and W. (*Univ. Michigan Eng. Research Bull.* No. **11**, 1928, 68; this *J.*, 1929, **41**, 416) regarding the effect of grain-size on the stability of a metal at high temperature.—S. G.

Change of Electrical Conductivity of Liquid Metals in a Magnetic Field. Ibrahim Fakidow and I. Kikoin (*Z. Physik*, 1932, **75**, 679).—The electrical resistance of liquid sodium–potassium alloy is found to increase according to a linear law both in weak magnetic fields of the order 0·5 kilogauss and in strong fields up to 12 kilogauss.—J. S. G. T.

On the Problem of Grain Segregation. E. Scheuer (*Light Metals Research*, 1931, **1**, (21), 2–9).—Translated from *Z. Metallkunde*, 1931, **23**, 237, 282. See *J.*, this volume, p. 159.—J. C. C.

III.—CORROSION AND PROTECTION

(Continued from pp. 354–361.)

CORROSION

Corrosion of Aluminium. B. van der Burg and C. A. Koppejan (*Milk Ind.*, 1932, **12**, (11), 81–85).—The protective action of sodium silicate against corrosion of aluminium, known to be effective for such alkaline detergents as sodium carbonate, is investigated for solutions of trisodium phosphate. It is concluded that with a 5% solution of the crystallized salt, the addition of 0·25% of waterglass is not in all cases sufficient to prevent corrosion.—H. H.

The Behaviour of Aluminium and Aluminium Alloys in Hydrogen Peroxide Solutions. W. Wiederholt (*Korrosion u. Metallschutz*, 1932, **8**, 4–15).—When aluminium sheets are left in contact with pure water a fine regular film of corrosion product is formed which prevents further action. Addition of 1% of hydrogen peroxide to the water causes rapid thickening of this film, and the bubbles of oxygen liberated by the decomposition of the peroxide adhere to the surface of the metal, preventing growth of the protective film and consequently causing local pitting. These pits form under the oxygen bubbles and are surrounded by growths of aluminium hydroxide; with progress of time the action becomes completely localized at these spots, and the remainder of the metal is covered with a thick protective film. The rate of corrosion of the metal is entirely dependent on the number of adherent gas bubbles in dilute peroxide solutions. As the concentration of the peroxide is increased its acidic character more and more dominates the reaction, and the corrosion products become gradually looser and more flocculent, so that eventually no adherent film is formed and the metal corrodes evenly all over the surface, but the rate of corrosion is extremely small, owing to the feebly acid character of the peroxide; experiments indicate a life of 200 years for sheet 1 mm. thick in solutions containing 5–30% of hydrogen peroxide. In more concentrated solution the oxidizing power of the peroxide is the determining factor in the corrosion process; a strongly adherent and highly protective film resembling that produced by anodic oxidation is formed on the surface of the metal, and corrosion then ceases. This film is sufficient to prevent corrosion of aluminium in 10% hydrochloric acid and in *N*-sodium hydroxide solutions. Addition of sodium silicate to weak peroxide solutions prevents to a considerable extent the local pitting action mentioned above. Aluminium alloys behave similarly to pure aluminium towards hydrogen peroxide solutions.—A. R. P.

The Effect of Additions of Water-Glass in Reducing the Corrosion [of Aluminium and Its Alloys] by Bromine Water, Chlorine Water, and Solutions of Bleaching Powder. H. Bohner (*Hauszeit. V.A.W. u.d. Erftwerk A.G. Aluminium*, 1931, **3**, 347–348).—The corrosion of aluminium, Silumin, and Lautal by saturated chlorine or bromine water, by bleaching powder solution, and by domestic, brewery, and dairy disinfectants and cleansers containing chlorine and alkali is completely or partly prevented by addition of sodium silicate.—M. H.

Investigation of the Corrosion of Light Alloys. Anon. (*Light Metals Research*, 1931, **1**, (20), 2–11).—Cf. *J.*, this volume, p. 82. A translation of a report issued by a Commission appointed by the Bureau International de l'Aluminium to select standard methods of testing the corrosion-resistance of aluminium alloys. The tests are divided into "rapid tests" and "proper corrosion tests"; and the original should be consulted for detailed instructions and dimensions of the corrosion vessels and test-pieces. The rapid tests proposed are: (1) Mylius' test, in which the maximum temperature reached when 20 c.c. of 10% hydrochloric acid at 20° C. are poured on a specimen having 2000 mm.^{2} of surface is observed; (2) gas volume test, in which the time required for 50 c.c. of gas to be evolved is recorded; (3) Mylius' activated corrosion test, in which the loss of weight after immersion for 24 hrs. in a solution containing 1% of sodium chloride and 3% of hydrogen peroxide is recorded. The "proper" tests specified are: (1) modified Mylius' test in which tensile test specimens are immersed in a constantly stirred solution maintained by daily additions at a composition of 1% of sodium chloride plus 2% of hydrogen peroxide. The diminution of breaking load and elongation after fixed intervals are determined; (2) solubility test, in which the loss of weight of totally immersed specimens is measured; (3) salt-spray test; (4) special immersion tests; (5) alternate immersion test.—J. C. C.

Aluminium as Corrosion Resistant. S. Gill (*Oil and Gas J.*, 1929, **28**, (29), 112, 237–238; *J. Inst. Petrol. Tech.*, 1930, **16**, 95A).—See this *J.*, 1930, **43**, 506.—S. G.

The Corrosion of Copper. L. W. Haase (*Cuivre et Laiton*, 1932, **5**, (72), 61–69).—In the first section, which deals with attack by chemical agents, the particular points discussed are the effects of free and dissolved gases, of organic salts, acids and bases, and of organic compounds. In the second section the incident electrochemical reactions which occur during corrosion are studied and the formation of protective coatings is described and discussed. The ultimate object of the article is the recommendation of copper pipes and conduits in domestic and public services.—W. A. C. N.

[Contribution] to the Knowledge of the Corrosion-Resistance of Copper, Tin-Bronzes, and Tin to Inorganic Acids.—I. W. Claus and H. Fincke (*Z. Metallkunde*, 1932, **24**, 64–66).—The resistance to corrosion by hydrochloric acid of chill-cast and subsequently annealed and polished samples of copper, tin, and copper–tin alloys with 3, 6, 10, 14, 20, and 32% tin has been measured by determining the loss in weight after shaking for 8 hrs. The losses in 3·03% acid were 1·9, about 5·7, about 4·7, and 3·6 mg./cm.^{2} for copper, the α-bronzes, the alloys with 20 and 32% tin, and tin respectively. The effect of 4·8% acid is similar, but the losses in weight are larger. The losses in weight of the alloys in 15·3% acid are much smaller than for more dilute acid and nearly equal to those of copper and tin.—M. H.

[Contribution] to the Knowledge of the Corrosion-Resistance of Copper, Tin-Bronzes, and Tin to Inorganic Acids.—II. W. Claus and H. Fincke (*Z. Metallkunde*, 1932, **24**, 112–114).—Losses in weight in mg./cm.^{2} after 8–58 hrs. in hydrochloric acid (5·07%) are diagrammatically given of annealed and unannealed samples, and losses in weight in grm./m.^{2}/day are tabulated for copper, tin, and tin-bronzes under the attack of hydrochloric acid of different concentrations, sulphuric acid (4·85% and 10·6%), and phosphoric acid (5·1%). A scale of stability was developed which permits the evaluation of the corrosion-resistance of materials. According to this scale, the materials investigated are unstable towards hydrochloric acid and slightly stable towards sulphuric and phosphoric acids.—M. H.

Effect of Cold-Rolling and Annealing on Solubility of Cartridge Brass in Chromic Acid. Joseph D. Parent (*Indust. and Eng. Chem.*, 1932, **24**, 318).—Determinations were made of the solubility of cartridge brass of different degrees of cold-work, as rolled and after annealing at 450° C. and 800° C., in aqueous solutions containing 50 grm. sodium bichromate and 35 c.c. concentrated sulphuric acid per litre. The samples were set in a glass stirrer, rotated in a specially-designed apparatus which is illustrated and described. The Rockwell hardness, grain-size, and grain orientations were determined, the results of the two former being plotted, together with corrosion loss, against degree of reduction, for each series, unannealed, and annealed at 450° and 800° C. respectively. The grain-size in itself gives no indication of the corrosion loss to be expected. The factors of importance are: inner stresses; chemical homogeneity; physical homogeneity; and orientation of the grains.—F. J.

Corrosion of Tinplates Used in the Manufacture of Containers for Canned Foods. G. Gire (*Ann. falsif.*, 1931, **24**, 355–362; *C. Abs.*, 1931, **25**, 5471).—Experiments are described on the rate of corrosion of tinplate in dilute solutions (0·01–0·1*N*) of acetic, oxalic, tartaric, citric, malic, and lactic acids, under conditions approximating to those to which are subjected containers for canned foods. Although the experiments constitute only the preliminaries of a more extensive investigation, they showed clearly that acetic acid very readily exerts a local corrosive action, which is attributed to intensive electrolytic action at the points where the acid has bared the iron, and that other acids readily dissolve tin.—S. G.

Corrosion in Tinplate. Eduard Nehring (*Konserven-Industrie*, 1931, **18**, 280–282; *C. Abs.*, 1931, **25**, 5657).—An explanation of the rôle of oxygen in the corrosion by foods preserved in tin. The importance of steam exhausting or of vacuum sealing is emphasized.—S. G.

Zinc in the Element Cell. E. Schrader (*Z. Metallkunde*, 1931, **23**, 301–305).—The more severe corrosion on one side than on the other, of zinc sheet containing 1% lead by dilute acid, is due chiefly to the different conditions of the surfaces of the horizontally cast ingot. The upper plane of the ingot contains more impurities and cavities, &c. (as shown by numerous photomicrographs); the latter collect oxides, metallic particles, and lubricant consequently the "upper" side of the sheet is more attacked than the "lower" side. This produces severe pitting of the zinc element in the Leclanché cell. Observation of the changes in the surfaces during the whole rolling process has to some extent revealed the causes of severe corrosion. Practical hints are given.—M. H.

Corrosion of Metals by Milk. Effects of Operating Conditions on Corrosion in Various Parts of Pasteurizing Equipment. H. A. Trebler, W. A. Wesley, and F. L. Laque (*Indust. and Eng. Chem.*, 1932, **24**, 339–350).—The corrosion of nickel, copper, nickel–brass, an alloy containing nickel 83, chromium 12, iron 5%, and an alloy containing nickel 8, chromium 18, iron 74%, in sweet milk was investigated. Nickel was corroded only slightly in milk being heated to and kept at the pasteurizing temperature. The normal increase in rate of corrosion, which accompanies a rise in temperature of most corrosive media, was prevented in a positive manner by the formation of a protective film on nickel favoured by air supersaturation and high rate of flow of the milk. When cooling milk from the pasteurizing temperature, there was no protective film formation, so that the corrosion of nickel was normal, depending on aëration, temperature, and velocity. Corrosion was appreciable during the initial stages of cooling, decreasing steadily with fall in temperature. The dual effect of high aëration and high velocity in increasing the rate of corrosion under certain conditions and decreasing it by accelerating protective-film formation under other conditions accounted for difficulties previously experienced. Nickel–brass behaved similarly to nickel, but copper was not noticeably protected on heating. The two chromium-containing alloys were resistant under all conditions, but a limited number of tests only was applied to the high-iron alloy. Galvanic action, due to differences in metal, aëration, or temperature, was unimportant, as was also the metal content of the milk. The results are directly applicable to plant operations and will enable the manufacturer and operator to use nickel with confidence in the larger part of pasteurizing equipment and to obviate the difficulties associated with its use in the particular pieces of equipment where corrosion is appreciable.—F. J.

Corrosion by Fruit Preserves. H. Serger (*Konserven Industrie*, 1930, **17**, 621–623; *C. Abs.*, 1931, **25**, 5717).—To evaluate the tendency of fruit juice or canned fruit to corrode, the substance is placed in a small Tantal metal dish and stirred with a zinc stirrer. The potential developing between the two metals is measured and compared with that of $0{\cdot}1N$ oxalic acid. The corrosion number (d) is $10b/a$; b equals e.m.f. of fruit juice and a equals e.m.f. of oxalic acid solution.—S. G.

The Use of Metals in the Textile Industry. ——Russina (*Z. ges. Textil-Ind.*, 1931, **34**, 393–394; *C. Abs.*, 1931, **25**, 5773).—A study was made of the action of bleaching liquors containing chlorine and oxygen on 5 metals and alloys. In the case of chlorine, tests were made in a bath with 2–2·5 grm. active chlorine per litre, and titrations were made with thiosulphate after 2 and 20 hrs. With nickel and Monel metal no loss of active chlorine occurred in 2 hrs., but a considerable loss in 20 hrs., also a precipitation of NiO and formation of oxycellulose. Newly polished surfaces resisted the action somewhat longer than

previously corroded specimens. Iron showed a gradual rusting and loss of active chlorine in the bath; this action was retarded by adding sodium hydroxide. V2A metal showed no action, and phosphor-bronze very little. Resistance to oxygen was tested in baths containing sodium peroxide at 70°–80° C., stabilized with water-glass. Titrations were made with potassium permanganate after 1·5 and 2·5 hrs. V2A metal, nickel, and Monel metal showed slight losses of oxygen. Iron and phosphor-bronze showed high losses and oxidation of cellulose. Although ordinary copper alloys give poor results in tests, they are widely used in bleaching apparatus; evidently the hardness of the water causes a protective coating to form. V2A metal, which resists both chlorine and oxygen, is said to be the best of the materials tested.—S. G.

Destructive Action of Phosphoric Acid on Metallic Alloys. V. K. Pershke, M. P. Kapostuin, and E. V. Yushmanov (*J. Chem. Ind.* (*Moscow*), 1931, **7**, 875–877; *C. Abs.*, 1931, **25**, 5655).—[In Russian.] Experiments are described on the resistance of cast-iron and copper alloys containing tin, zinc, aluminium, lead, antimony, and nickel to the action of 84·7% phosphoric acid at temperatures from 20° to 150° C. The results are given in 3 tables. Alloys containing 78% copper are resistant to phosphoric acid, with 63–80% copper they are satisfactory, but with a copper content lower than 63% they are not resistant to phosphoric acid. Alloys with the same copper content and nearly equal percentages of lead, aluminium, and antimony show the same resistance. With the same copper content, nickel instead of zinc and lead, or tin and zinc and lead instead of zinc increase the resistance; lead instead of tin has no influence; lead and antimony instead of zinc do not change the resistance of the alloy. Alloys with a high content of lead and zinc are not resistant. Brass with a copper content of 85–90% and copper-nickel alloys with 80% copper are recommended for apparatus coming into contact with concentrated phosphoric acid at 150° C.—S. G.

Combating Corrosion in Oil Refineries. R. L. Duff (*Oil and Gas J.*, 1929, **28**, (29), 150, 274, 276; *J. Inst. Petrol. Tech.*, 1930, **16**, 74A).—See this *J.*, 1930, **43**, 506.—S. G.

Metals that Resist Alkali Corrosion. John L. Everhart (*Chem. and Met. Eng.*, 1932, **39**, 88).—Metals generally represented as excellent in their resistance to caustic soda and other alkaline liquors are not satisfactory in plant liquors, owing to the small quantities of impurities present therein and to the combination of corrosion and erosion caused by the flow of liquors during processing. Typical analyses of such liquors are given, as well as of metals and alloys tested and the corrosion results. Aluminium gives good results in sodium carbonate and calcium chloride liquors; copper fair results in caustic soda manufactured by the lime process, and in electrolytic caustic soda, and good results in calcium chloride. Nickel and Monel metal are excellent in caustic soda (lime process and electrolytic), nickel being fair in ammonium chloride and Monel metal good in calcium chloride. A nickel-chromium-iron-molybdenum alloy gives the best all-round results, but, in general, owing to cost considerations, cast iron and steel are more economical to use, even though replacements are more frequent.—F. J.

The Handling of Corrosive Gases. Thomas H. Chilton and William R. Huey (*Indust. and Eng. Chem.*, 1932, **24**, 125–131).—The following non-ferrous metals are recommended, together with alloy steels and various other materials. *I.—Moist Gases.*—Lead for moderate temperatures and where strength is not required, in the case of sulphurous gases. Tantalum is the only non-ferrous metal recommended for nitrous acids containing halogen acids; chemical lead (for construction of flues) and antimonial lead (for fans) where mixtures of nitrous and sulphurous acids are concerned. Tantalum and platinum resist moist halogen acid vapours and copper can be used for hydrofluoric acid vapours, but only in the absence of oxygen, if the vapours are moist, in which

case an alloy containing copper 88, aluminium 8, and iron 4% is suitable. Tantalum is suitable for moist chlorine and aluminium or aluminium-coated iron for moist hydrogen sulphide. Nickel and nickel alloys are serviceable for moist ammonia at low temperatures, but are attacked in the presence of oxygen and at high temperatures. *II.* (*a*)—*High-Temperature Surface-Attack.*—Nickel 80, chromium 20% is recommended for temperatures up to 1150° C., pure nickel and an alloy containing nickel 72, cobalt 18, titanium 2·5, and aluminium 0·5% serving up to 700° C. Tantalum burns in air above 350° C., molybdenum requires high *vacua* to prevent oxidation, and even platinum oxidizes at high temperatures, but less rapidly when alloyed with rhodium. The addition of aluminium to the chromium–nickel alloys increases their resistance to hot sulphurous gases. Nickel for chlorinated hydrocarbon and air up to 400° C., and in addition to aluminium, for hot ammonia–air mixtures; nickel–copper alloys for superheated steam and copper for carbon monoxide, heated under pressure are the non-ferrous materials recommended. *II.* (*b*)—*Disintegration Attack.*—A nickel–chromium–aluminium alloy is promising for processes involving the use of hydrogen at high pressures and temperatures, whilst nickel 45: copper 55 alloy resists attack by hydrogen nitrogen or ammonia at normal pressure up to 1000° C.—F. J.

Corrosion and Conservation of Buried Metal Structures. P. J. Richards (*Colorado Sci. Soc. Proc.*, 1930, **12**, (8), 289–294).—The sampling of soils in order to determine their probable corrosive effect on metal pipes buried therein is briefly described. The presence of chlorides or sulphates in the soil is most harmful; sulphides may be dangerous on account of their oxidation to sulphates in course of time. Limestone or other forms of calcium carbonate may have an inhibiting effect on corrosion, even when corrosive salts are present. All soil acids should be regarded as corrosive. Mountainous and arid regions are usually alkaline, whilst soils covered with luxuriant vegetation are generally acid. An important factor determining the corrosion is the amount of moisture in the soil. Coatings for buried metal should be chosen to suit the temperature conditions; they should not soften in hot weather or become brittle in cold weather. Wrapped coatings, although usually having little or no resistance to soil waters, are desirable where severe abrasion may be expected. Paints containing vegetable oils should not be used in alkaline soils. Concrete is subject to attack in certain soils.—E. S. H.

Corrosion in Marine Engineering. —— Andreae (*Metallurgist* (Suppt. to *Engineer*), 1931, **7**, 140–142).—A summary of a paper by A. in *Korrosion u. Metallschütz*, 1931, **7**, 125. See *J.*, this volume, p. 304.—R. G.

On the Theory of Metal Dissolution.—III. M. Straumanis (*Z. physikal. Chem.*, 1931, [A], **156**, (2), 150–158).—From thermodynamic considerations the various faces of a metal crystal must have the same equilibrium potential, if the valence of the ions is not changed. The differences observed in the rate of dissolution of the various crystal faces cannot therefore be due to differences of potential but may be explained by the existence of regularly oriented inclusions of impurities the arrangement of which differs in the various faces and thus affects the factors which determine the rate of dissolution; these factors are: the number of local elements per unit area, their resistance, and the overvoltage of the cathodes.—B. Bl.

Grain-Size, Eutectic, and Corrosion. M. Werner (*Z. Metallkunde*, 1932, **24**, 85–87).—New experimental evidence is given in support of W.'s views on the relationship between grain-size, eutectic, and corrosion resistance of lead (cf. this *J.*, 1931, **47**, 20). The grain-size of lead is considerably increased by addition of very small amounts of those metals (bismuth, nickel) which pass into solid solution. The view is confirmed that local elements act favourably on the corrosion resistance (provided that insoluble corrosion products are formed) if the added metal (*e.g.* nickel) is nobler than lead in the reagent (*e.g.*

concentrated sulphuric acid). The favourable effect is annulled if the nobler metal forms with lead considerable amounts of eutectic (silver, arsenic), but this difficulty can be overcome by introducing the second metal mechanically by means of small shavings or electrolytic deposits. Lead can be made resistant to corrosion by alternate electrolytic deposition of lead and silver on the surface followed by rolling.—M. H.

Studies of the Corrosion of Metals. T. Kuczynski and M. Smialowski (*Light Metals Research*, 1931, 1, (21), 16).—An abstract from *Przemysl Chem.*, 1931, **15**, 52, 99. See *J.*, this volume, p. 161.—J. C. C.

On a New Method of Accelerated Corrosion Testing. L. W. Haase (*Chem. Fabr.*, 1931, 169–170, 184–185).—The usual methods do not continuously renew the corroding medium nor take into account its content of dissolved oxygen. The new electrometric method comprises passing the solution through 2 vessels each containing a platinum electrode and a specimen of the metal being tested, the solution being saturated with oxygen before it enters the second vessel. Each pair of electrodes can be connected direct to a voltmeter or across a high resistance so that the resistance to corrosion of the specimen in 2 different liquids or the resistance of 2 different specimens towards the same liquid can be compared. The method is applicable to the study of protective layer formation and of the effect of heat and mechanical treatment on the corrosion resistance of alloys.—A. R. P.

A New Apparatus for Testing the Resistance of Building Materials to Corrosion and Erosion. W. Denecke (*Chem. Fabrik*, 1931, 358–359; *C. Abs.*, 1931, **25**, 5746).—The apparatus was designed by Th. Meierling, and consists of 2 vertical glass vessels connected at the bottom and near the top, containing the corrosive solution. A propeller made of the metal to be tested is attached to a shaft in one vessel and circulates the solution in which abrasives may be suspended.—S. G.

Rapid Corrosion Testing. K. Taussig (*Light Metals Research*, 1931, **1**, (21), 14).—Abstracted from *Arch. Wärmewirtschaft*, 1931, April. Describes testing methods due to Tödt and Duffek in which the electrolysis current is measured between the metal under test as anode and a platinum or mercury cathode.
—J. C. C.

PROTECTION

The M.B.V. Process: an Efficient Method of Protecting the Surface of Aluminium and Its Alloys. —— Eckert (*Metallwaren Ind. u. Galvano-Tech.*, 1932, **30**, 81–83).—The process comprises immersion for 3–5 minutes of the thoroughly degreased article in a hot solution (90°–100° C.) containing 5% of sodium carbonate and 1·5% of sodium chromate. At 70° C. the protective film requires 1 hr. for its formation, but this time may be reduced to 20 minutes by addition of 0·25% of sodium hydroxide. The deposited film has a grey colour and is sufficiently hard and dense to be polished with a brush without fracture. The process is suitable for the treatment of aluminium and its light alloys with the exception of those containing copper.—A. R. P.

Some Experiments on Tin Coating. Idris Williams (*Swansea Tech. College Met. Soc. Papers*, 1932, 1–15).—Describes some experiments carried out, under commercial conditions, on the effect of various factors on the yield of tin on tinplate. The effect of pickling, and cold-rolling the sheets was to decrease the amount of tin consumed per sheet up to a certain number of passes, after which the effect of further cold-rolling was nil. Passing the sheets twice through the tinning pot did not increase the tin consumption.—R. Gr.

Mottled Tinplates. —— (*Mech. World*, 1931, **90**, 371–372).—Editorial note on the paper by J. C. Jones on Mottled Tinplates, read before the Iron and Steel Institute. See *J.*, this volume, p. 360.—F. J.

Skimmer for Galvanizing Vessel. M. L. H. (*Machinery* (*Lond.*), 1930, **37**, 266).—Brief illustrated description of a reciprocating blade device.—H. F. G.

Zinc and Cadmium for Preventing Corrosion. L. K. Wright (*Machinery (N.Y.)*, 1931, **37**, 343).—A brief discussion of the relative advantages of zinc and cadmium for the protection of articles by electroplating.—J. C. C.

Protection of Metals against Corrosion with Reference to Some Problems in Aeronautical Engineering. H. Sutton (*Mech. World*, 1931, **90**, 422–424; and *Met. Ind. (Lond.)*, 1931, **39**, 387–388).—Abstract of a paper read before the Royal Aeronautical Society. See *J.*, this volume, p. 234.—F. J.

Aircraft and Corrosion. Anon. (*Mech. World*, 1931, **90**, 420).—Editorial note on Sutton's paper (see preceding abstract).—F. J.

Varnishing, Colouring, and Painting of Copper. H. Breau (*Cuivre et Laiton*, 1932, **5**, (74), 113–115).—Copper is entering more and more into structural fitments and into the ornamentation of buildings both internally and externally. Protection against natural and artificial atmospheres is afforded by the use of varnishes and lacquers, whilst decorative effects may be obtained either by the use of coloured varnishes or of paint. A variety of effects can be obtained with the patina which copper assumes on exposure.—W. A. C. N.

Lacquer and the Canning Industry. A. Samson (*Chem. and Ind.*, 1932, **51**, 95–97).—Discusses the requirements of lacquers suitable for lining the tinned food container and the types of corrosion experienced. The lacquering process is briefly described.—E. S. H.

Modern Developments in the Paint and Varnish Industry. D. G. Hopkins (*J. Inst. Chem.*, 1932, (II), 148–151).—A lecture to the South Wales Sections of the Institute of Chemistry and the Society of Chemical Industry.—E. H.

Some Developments in the Use of Zinc Pigments. H. A. Nelson (*J. Amer. Zinc. Inst.*, 1931, **14**, 60–68).—Read before the American Zinc Institute. The use of zinc pigments is considered under 3 headings: (1) Zinc sulphide pigments in exterior paints. (2) Zinc pigments in special moisture-resisting paints for wood, and (3) Metallic zinc powder (zinc dust) as a pigment in protective coatings for metal. With regard to (3), the results of severe exposure tests on paints of different compositions used on aluminium, galvanized iron, and sheet zinc are given.—J. H. W.

IV.—STRUCTURE

(Metallography; Macrography; Crystal Structure.)

(Continued from pp. 362–364.)

Optical Hints for the Metallographer. L. V. Foster (*Heat-Treating and Forging*, 1932, **18**, 201–202).—The procedure for obtaining the best possible definition and resolution in microscopic work in metallography is described.
—J. H. W.

Large Grain-Size in Aluminium Wire. Clement Blazey (*Chem. Eng. and Min. Rev.*, 1932, **24**, 193–196).—In a certain consignment of wire used for making rivets, it was found impossible to make good rivets. The only difference in this wire from wire giving good rivets was the shape of the impression used for taking the Brinell hardness, that of the satisfactory wire being circular and that of the unsatisfactory wire being deformed, the latter material showing slightly the greater hardness. It was further established by micro-examination that the unsatisfactory wire had a relatively large grain-size. It was therefore concluded that such coarse-grained metal would behave in a peculiar manner under other types of cold-working, and this was confirmed by direct experiment with annealing and tensile tests and by hammering.—J. H. W.

The Application of the Polarization Microscope in the Investigation of Copper Alloys. M. von Schwarz (*Z. Metallkunde*, 1932, **24**, 97–103).—Translated from *Metallurgia*, 1931, **4**, 180–186; see *J.*, 1931, **47**, 659–660.—M. H.

On the Crystal Structures of the Compounds Formed in the Antimony–Cadmium System. (Remarks on the Paper by M. Chikashige and T. Yamamoto). E. Abel, J. Adler, F. Halla, and O. Redlich (*Z. anorg. Chem.*, 1932, **205**, 398–400).—Cf. this *J.*, 1931, **47**, 534. A critical discussion of the paper by C. and Y. in the light of former investigations by the authors (see this *J.*, 1928, **40**, 504; 1930, **43**, 525) shows that the paper by C. and Y. contains no experimental evidence for the existence of two modifications of the compound CdSb which has a rhombic and not a hexagonal lattice. The arguments advanced by C. and Y. against the existence of the metastable compound Cd_3Sb_2 are not valid.—M. H.

The Crystal Structure of β-Zirconium. W. G. Burgers (*Z. anorg. Chem.*, 1932, **205**, 81–86; and *Nature*, 1932, **129**, 281).—β-Zirconium, stable above $862 \pm 5°$ C. (cf. *J.*, this volume, p. 70), has a cubic body-centred lattice with two atoms in the elementary cell, $a = 3{\cdot}61$ A. $d_{calc.} = 6{\cdot}39$ at 867° C. An X-ray camera for the preparation of "Drehkristall"-photograms of wires glowing in vacuum or in any desired gas is described.—M. H.

The Diffraction of Electrons in Single Crystals. J. J. Trillat and Th. v. Hirsch (*Z. Physik*, 1932, **75**, 784–803).—The diffraction of electrons having a velocity corresponding with 40 k.v. in hammered gold and platinum foil indicates that these materials have a very pronounced fibrous structure. Evidence of single-crystal diffraction patterns is also found. Plastic deformation due to hammering affords an explanation of the characteristic features of the latter patterns. The strain of the crystal lattice can be partly removed by suitable heat-treatment. In the case of gold leaf the fibrous structure is simple in character with the axis [100] parallel to the normal to the foil; in platinum foil the fibrous structure is more complex, the axes [100] and [110] being parallel to the normal to the foil.—J. S. G. T.

The Surface Electrons. J. E. Nyrop (*Phys. Rev.*, 1932, [ii], **39**, 967–976).—The Sommerfeld electron theory of metals is extended to include the case in which the surface of the metal is covered by a film or gas of surface electrons. These are defined as those electrons which are enabled to penetrate the surface of the metal, but which cannot escape completely owing to the potential barrier at the surface. The ordinary and selective photoelectric effects, and the case of thermionic emission are discussed under this assumption, which is shown to be in general agreement with the facts, although the equations are different from those of the Sommerfeld theory where the surface electrons are neglected. The equation for the thermionic current is of the form $J = AT^{\nu}e^{-\kappa/kT}$, as compared with the similar equations involving T^2 and $T^{1/2}$ of the Sommerfeld and classical theories respectively. The effects of the surface electrons on adsorption and catalytic reactions are discussed.—W. H.-R.

Secondary Structure and Mosaic Structure of Crystals. F. Zwicky (*Phys. Rev.*, 1932, [ii], **40**, 63–77).—The theory of the secondary structure of crystals (Zwicky, *Proc. Nat. Acad. Sci.*, 1931, **17**, 524; *Phys. Rev.*, 1931, [ii], **38**, 1772; *J.*, this volume, p. 75) is discussed. Z. uses the terms "secondary structure" and "mosaic structure" to distinguish between thermally stable and pseudo-stable configurations of crystal lattices respectively. Previously these terms were used indiscriminately. Two types of secondary structure are (*a*) those involving permanent electric polarization, and (*b*) those involving a tendency to form linear or plane crystals. The details of the paper here refer generally to salts, but references to metals are given. (2) A possible cause of the mosaic structure is the latent heat of fusion, since this must be carried away, necessitating a temperature gradient which may strain the crystal at the time of formation. Another cause may be the release of gases. Slow growth from vapour in a vacuum prevents many of the disturbing effects.—W. H.-R.

V.—ANALYSIS

(Continued from pp. 364–366.)

Surface Effects on Assay Beads Caused by Metals of the Platinum Group. J. L. Byers (*Amer. Inst. Min. Met. Eng. Preprint*, 1932, Feb., 1–17).—The effect of 0·02–5% of the metals of the Pt group separately on the structure of the surface of Au and of Ag beads after cupellation at 900°–950° C. is shown in a series of photomicrographs and a full description of the appearance (crystal structure, colour, encrustations, &c.) of the surface is given, for details of which the original must be consulted. In all cases characteristic effects were observed which serve to indicate the presence of Pt metals in a cupellation bead. No tests with other than binary mixtures are reported and such mixtures rarely occur in practice. [*Note by abstractor*: As it is impossible to ensure complete removal of Pb under the conditions under which the tests were made many of the effects observed are probably influenced by the presence of Pb in the bead.]—A. R. P.

Silver–Bismuth Alloys in Quantitative Analysis. George W. Batchelder and Loren C. Hurd (*J. Chem. Education*, 1932, **9**, 929–931).—The preparation of small quantities of Ag–Cu alloys for chemical analysis involves difficulties owing to segregation. Ag–Bi alloys, however, have relatively low melting points up to 50% Ag and a suitable series of such alloys was prepared by melting bismuth, adding precipitated Ag, stirring, and granulating in water.—J. W.

Detection of Magnesium by Coloured Drop Reactions. N. A. Tananaeff (*Z. anal. Chem.*, 1932, **88**, 93–94).—The solution is evaporated with H_2SO_4 and the residue heated with NH_4OH until all NH_4 salts and free H_2SO_4 are expelled. The residue is dissolved in H_2O and a drop of the solution placed on filter paper with a drop of NH_4OH and a drop of $HgCl_2$ or $AgNO_3$ solution; a brown or yellow spot indicates the presence of Mg. If a drop of the solution, a drop of NH_4OH, and a drop of phenolphthalein are placed on filter paper, which is then dried and moistened with H_2O, a pink spot appears in the presence of Mg.—A. R. P.

Electrochemical Detection of Minute Quantities of Mercury. E. Schmidt and E. Tornow (*Chem.-Zeit.*, 1932, **56**, 187–188, 206–207).—The method depends on the deposition of the Hg on an Al cathode using a C anode; the deposited Hg causes rapid oxidation of the Al even when as little as 0·001 mg. of Hg is present.—A. R. P.

The Application of Hexamethylenetetramine as an Analytical Reagent for the Determination of the Metals of the Ammonium Group in the Presence of Manganese, Nickel, Cobalt, and Magnesium. Priyadaranjan Rây [with Akshoya Kumar Chattopadhya and Dayananda Bhaduri] (*Z. anal. Chem.*, 1931, **86**, 13–24).—U, Zr, and Th can be separated quantitatively from Zn, Mn, Ni, Co, and Mg by precipitation with $(CH_2)_6N_4$. The method is also applicable to the separation of Al and Ti from Mn, Ni, Co, Mg, and small quantities of Zn; if much Zn is present, the Al and Ti precipitates will contain Zn. When the solution contains P_2O_5 this is completely removed provided that sufficient Fe or Al is present.—A. R. P.

On the Determination of Beryllium. L. Fresenius and M. Frommes (*Z. anal. Chem.*, 1932, **87**, 273–285).—A critical review of recent methods which have been proposed for the determination of Be, especially in steels.—A. P.

On the Gravimetric Determination of Beryllium and its Separation from Aluminium by Guanidine Carbonate. Ant. Jílek and Jan Kota (*Z. anal. Chem.*, 1932, **87**, 422–437).—Cf. *J.*, this volume, p. 88. Be is precipitated by addition of 6 grm. of guanidine carbonate to a cold neutral (methyl red) solution of the chlorides containing NH_4 tartrate; 5 c.c. of 40% H·CHO solution are also added to overcome the effect of the NH_4 salt.—A. R. P.

On the Determination of Beryllium in Alloy Steels and Ferro-Beryllium. Horst Eckstein (*Z. anal. Chem.*, 1932, **87**, 268–272).—Ferro-beryllium of commerce is stated to contain 85% Be, 15% Fe, 0·34% Mn, and 0·04% C and to be free from Si and Al. Be is determined by dissolution in aqua regia, precipitation of Fe and Be with NH_4OH, and determination of the Fe volumetrically in the weighed $BeO + Fe_2O_3$, BeO being taken by difference.
—A. R. P.

On the Determination of Bismuth as Metal. E. Rupp and G. Hamann (*Z. anal. Chem.*, 1931, **87**, 32–35).—Precipitation of Bi with H·CHO and NaOH gives high results, as the metal always contains Bi_2O_3. Addition of glycerol produces a purer precipitate, but it is preferable to dry and heat the precipitate in H_2 at 200°–250° C. before weighing.—A. R. P.

Determination of Calcium and Its Separation from Magnesium by Means of Sodium Tungstate. D. Katakonsiuos (*Praktika*, 1931, **4**, 400–404; *Chem. Zentr.*, 1932, **103**, I, 844).—Good results are obtained by precipitation of $CaWO_4$ from solutions containing NH_4OH and NH_4Cl if a large excess of Na_2WO_4 is used. The solubility of the precipitate is inversely proportional to the temperature, hence it is better filtered from a hot solution. The error should not exceed 0·0005 grm. Ca.—A. R. P.

The Application of Piperidinium Piperidyldithioformate to the Colorimetric Determination of Copper. R. G. Harry (*Analyst*, 1931, **56**, 736–737).—A nearly neutral solution of a Cu salt yields a yellowish-brown colour with alcoholic solutions of piperidinium piperidyldithioformate. Fe interferes, but Cd, Hg, and Bi are inert.—A. R. P.

Copper Determination by the Fluoride-Iodide Method. Henry N. Thomson (*Eng. and Min. J.*, 1932, **133**, 278–279).—Discusses the iodide method for the determination of Cu in the presence of Fe. Interference from Fe is prevented by the addition of a fluoride to form the stable compound Fe_2F_6, which does not react with KI. Standardization with Cu, and with Cu + Fe and fluoride gave a difference of 0·3% on a sample containing 25% Cu. The Fe content should run over 40 mg.; below this the solution value drops appreciably. Details of the procedure for determinations are given, and notes attached on the effects of Fe, Pb, As, and Mn. A number of references is included.—R. Gr.

The Determination of Copper in the Presence of Iron with Salicylaldoxime. Wilhelm Reif (*Z. anal. Chem.*, 1932, **88**, 38–40).—The solution is treated with tartaric acid, then with NH_4OH until alkaline, reacidified with $CH_3{\cdot}CO_2H$, and treated cold with a 5% alcoholic solution of salicylaldoxime. The precipitate is collected on a porous filter, washed, dried at 105° C., and weighed; it contains 18·95% Cu.—A. R. P.

Microelectrolytic Determination of Copper in Ammoniacal Solution. A. Okáč (*Z. anal. Chem.*, 1932, **88**, 108–119).—The solution, containing 0·5 c.c. of NH_4OH (*d* 0·88) in 6–7 c.c. with 0·2–5 mg. Cu, is stirred with a current of CO_2 from a capillary and electrolyzed at 2 v. for 10 minutes. Full details of the apparatus are given in the paper.—A. R. P.

The Electroanalytical Determination of Gallium.—I. Erich Reichel (*Z. anal. Chem.*, 1932, **87**, 321–332).—The metal is deposited from a solution of $Ga_2(SO_4)_3$ containing 10–40 grm. of $(NH_4)_2SO_4$ per 0·1 grm. of Ga after adjusting the p_H to 10·4–10·8 with NH_4OH. A rotating Pt cathode is used at 5 amp. and the solution is slowly heated from 60° to 80° C. during electrolysis. Allowance must be made for a small quantity of Pt carried over from the anode. The Ga alloys with the Pt cathode, but can be removed by treatment with HNO_3.—A. R. P.

Determination of the Factor for Converting the Weight of Electrodeposited Lead Peroxide into Lead. Manuel Garcia (*Quim. e Ind.*, 1932, **9**, 1–2; *Chem. Zentr.*, 1932, **103**, I, 1931).—For the electrolytic determination of Pb the sample is dissolved in a solution of 8 grm. of electrolytic Cu in 55 c.c. of

1 : 1 HNO_3 and the resulting solution (filtered, if necessary) is electrolyzed at 0·25 amp. The PbO_2 deposited on the anode is washed with dilute HNO_3, then with H_2O, dried at 110° C., and weighed; for weights between 0·2 and 1 grm. the factor is 0·851, and for weights between 0·01 and 0·1 grm., 0·845. —A. R. P.

On the Precipitation of Manganese as Manganese Ammonium Phosphate. P. Nuka (*Z. anal. Chem.*, 1932, **87**, 7–26).—A full account in German of work previously published in Latvia (see *J.*, this volume, p. 89).—A. R. P.

The Determination of Molybdenum by Potassium Permanganate. E. Carrière and Raymond Lautié (*Compt. rend.*, 1932, **194**, 1167–1168).—Previous methods of reducing Mo salts by Zn and H_2SO_4, and Al from Pisani, 1864, to Kassler, 1928, are reviewed, and experiments on the efficiency of the Zn–H_2SO_4 method are described. Pure potassium molybdate, previously analysed, was dissolved in 150 c.c. dilute H_2SO_4 in an Erlenmeyer flask and 15 grm. pure Zn wire were added. The reduction was effected at a temperature of 50°–60° C. in an atmosphere of CO_2. When the action was complete, the solution was cooled and filtered and titrated with $KMnO_4$ in an Erlenmeyer flask in an atmosphere of CO_2. The results of the titration showed that the Mo had been reduced to a salt corresponding with the oxide Mo_2O_3. Increasing the amount of Zn and/or acid gives the same results, but with too little Zn, the reduction is incomplete. With Zn and HCl, less concordant results are obtained.—J. H. W.

Method for the Determination of Small Quantities of Mercury. M. Jean (*Bull. Soc. Pharm. Bordeaux*, 1931, **3**, 176–183; *Chem. Zentr.*, 1932, **103**, I, 1271–1272).—The Hg is precipitated as metal by boiling with H·CHO and redissolved in 0·02*N*-I solution; excess I is expelled by boiling, the HgI_2 converted into iodate by oxidation with $KMnO_4$ or Br, and the iodate determined iodometrically.—A. R. P.

Very Delicate Method for the Detection and Nephelometric Determination of Very Small Quantities of Mercury. J. Golse and M. Jean (*Bull. Soc. Pharm. Bordeaux*, 1931, **3**, 168–176; *Chem. Zentr.*, 1932, **103**, I, 1272).—The method depends on the formation of a turbidity when KI and an alkaloid are added to a Hg salt. The solution should contain not less than 2 mg. of Hg per l.; 1 c.c. is treated with 0·1 c.c. of 2·5% strychnine sulphate solution and 0·1 c.c. of 0·5% KI solution, and the resulting turbidity is compared with that produced under similar conditions by solutions of known Hg content. With more dilute Hg solutions 25 c.c. are treated with 0·1 c.c. of a 0·1% solution of As_2O_3 in NaOH, and the Hg and As are precipitated together by means of Bougault's reagent. The precipitate is dissolved in Br and after neutralization the analysis is finished as above.—A. R. P.

Microelectrolytic Nickel and Cobalt Determination in Ammoniacal Solution. A. Okáč (*Z. anal. Chem.*, 1932, **88**, 189–194).—The solution containing 1 c.c. of NH_4OH in 6–7 c.c. is electrolyzed for 15 minutes with 4 v. Details are the same as for the determination of Cu (see Okáč, abstract above).—A. R. P.

Estimation of Silicon in Aluminium and its Alloys. W. R. Gamble (*Met. Ind.* (*Lond.*), 1932, **40**, 446).—The following method of estimating Si up to 1% in Al and Al alloys containing not more than 1·5% Fe is said to give both rapid and reliable results. It is based on the Winkler method for the estimation of soluble SiO_2 in natural waters and depends on the colour produced by soluble SiO_2 and $(NH_4)_2MoO_4$ in a slightly acid solution, the colour being proportional to the Si content when this is not more than 25 parts per million. 0·5 grm. drillings are treated with 60 c.c. hot water, 1 grm. Na_2CO_3, and 25 c.c. NaOH. 35 c.c. dilute H_2SO_4 are carefully added and the solution is boiled, filtered, and cooled. The filtration may be omitted in the case of pure Al. The solution is titrated for Fe against $KMnO_4$. NH_4OH is now added until slight permanent turbidity occurs, and the whole is diluted according to the

Si content. 100 c.c. are transferred to a Nessler tube, 4 c.c. 25% $(NH_4)_2MoO_4$ added, and sufficient dilute HCl to clear + 0·5 c.c. excess. The solution is allowed to stand for 10 minutes and its colour is then compared with colour standards. For the colour standards, 0·0343 grm. picric acid is dissolved and diluted to 1000 c.c., 1 c.c. of this solution diluted to 50 c.c. is equivalent to about 1 part per million of SiO_2. Alternatively, a permanent colour standard for silicic acid with a Hellige comparator may be used, which obviates errors due to coloured solutions.—J. H. W.

The Indirect Volumetric Determination of Sodium Based on the Reduction and Titration of the Uranium in Magnesium Sodium Uranyl Acetate. N. Howell Furman, Earle R. Caley, and Irl C. Schoonover (*J. Amer. Chem. Soc.*, 1932, **54**, 1344–1349).—The method has advantages over others as regards accuracy when quantities of Na below 10 mg. are to be determined, and is rapid. It can also be used for the determination of U.—R. G.

Volumetric Determination of Tin in White Anti-Friction Metals. D. Lombardo (*Met. italiana*, 1932, **24**, 10–20; *C. Abs.*, 1932, **26**, 1875.)—Cf. *J.*, this volume, p. 90. A study of the iodometric method for determining Sn in white metals shows that the theoretical factor can be used when Armco iron is employed to reduce Sn^{IV} in an atmosphere of CO_2 provided that less than 38% Pb is present. The results are slightly low with more Pb. The Sb content should be at least $\frac{1}{8}$ that of the Sn. Cu and As in normal amounts cause no interference.—S. G.

A Method for the Determination of Titanium as Phosphate. J. C. Ghosh (*J. Indian Chem. Soc.*, 1931, **8**, 695–698).—The method depends on the hydrolysis of $TiOSO_4$ solutions with $Na_2S_2O_3$ in the presence of $(NH_4)_2HPO_4$ and CH_3CO_2H followed by weighing of the ignited precipitate as $Ti_2P_2O_9$. Al is removed previously by fusion with Na_2CO_3, and Fe does not interfere, as it is reduced to $Fe^{\cdot\cdot}$ by the $Na_2S_2O_3$. [*Note by Abstractor.*—It is doubtful whether the substance weighed is of definite composition and many details of the process are vague.]—A. R. P.

Volumetric Determination of Vanadium and Chromium (Electrochemical Notes on the Reduction Activity of Metallic Copper). G. Scagliarini and P. Pratesi (*Atti R. Accad. Lincei* (*Roma*), 1931, [vi], **6**, 298–300; *Chem. Zentr.*, 1932, **103**, I, 1272).—Pentavalent V and sexavalent Mo are reduced to the ter- and penta-valent states, respectively, by metallic Cu in 10–15% H_2SO_4; the metals can then be determined by titration with $KMnO_4$. HCl and chlorides must be absent. Cu does not reduce quadri- to ter-valent Ti.—A. R. P.

Apparatus for the Works' Determination of the Total Zinc Coating on Steel. —— Goeke (*Chem. Fabrik*, 1931, **4**, 147–148).—The apparatus comprises a 100-c.c. glass bottle with a capacious hollow stopper in which the specimen is placed before the test is started. The stopper carries a short tube with a stopcock and a longer tube extended to the bottom of the bottle and terminating in a short upward bend. The latter tube is connected outside the bottle with a burette with an upper stopcock. For a test the specimen is placed in the stopper, and the bottle and longer tube are filled with *N*-HCl containing 3% $SbCl_3$, the stopcock above the burette is opened, the specimen dropped in the acid, and the volume of H_2 evolved measured by the amount of acid displaced into the burette; this volume multiplied by 0·00272 gives the weight of Zn on the specimen in grm., and by dividing this by 7100 times the area of the specimen the thickness of the coating in mm. is obtained.—A. R. P.

The Separation of Metals of the Third Analytical Group. R. Ripan (*Bul. Soc. Stiinte Cluj*, 1931, **6**, 280–285; *C. Abs.*, 1932, **26**, 1873).—The order in which the separation is effected varies somewhat from that in common use, but all the reactions recommended are well known.—S. G.

VI.—LABORATORY APPARATUS, INSTRUMENTS, &c.

[See also "Testing" and "Pyrometry."]

(Continued from p. 367.)

The Qualification of Tantalum as Material for Laboratory Apparatus. Bruno Fetkenheuer and E. Cremer (*Siemens Z.*, 1932, **12**, 168–171).—The losses in weight of tantalum sheet in various reagents used in analysis are tabulated. Tantalum is attacked by concentrated nitric acid, hydrogen fluoride, sulphuric acid (above 150° C.), and hot potassium hydroxide. In many cases it can be used as a substitute for platinum, to which it is, in some cases, even superior. Tantalum can be used as cathode in the electrolytic deposition of copper, zinc, nickel, cobalt, silver, gold, and cadmium, but not tin.—M. H.

A New Form of Dilatometer. W. E. Prytherch (*J. Sci. Instruments*, 1932, **9**, 128–131).—In this instrument a metal specimen of from 1 to 2 cm. in length, and 7 mm. in diam., is contained in a furnace, and the volume changes actuate the moving plate of a small condenser forming part of the series grid capacity of an oscillating valve circuit. Relatively large changes are thus caused in the mean steady anode current of the valve, and may be recorded on a thread recorder which also records the temperature of the specimen. The instrument is suitable for investigating transition changes in alloys where these are accompanied by a change in volume. The sensitivity is of the order one millionth of an inch, but in the present form of the instrument the absolute accuracy is very much less owing to gradual creep effects. Useful references to other types of dilatometer are given.—W. H.-R.

A New Method for the X-Ray Investigation of the Processes Concerned in the Elastic and Plastic Strain of Poly-Crystalline Metals. F. Regler (*Physikal. Z.*, 1932, **33**, 435–438).—The spherical reflection method of X-ray crystal analysis previously described by R. (*Z. Physik*, 1931, **71**, 371; 1932, **74**, 547) is discussed. The method is readily applicable to the detection of strains produced by the cold-working of steel, copper, and lead. The method permits plastic and elastic strains to be differentiated from one another. In both cases a rotation of the crystal lattice occurs, but in the case of elastic strains a deformation of the lattice is observed as well, but does not occur in plastic strains.—J. S. G. T.

On the Geometrical Design of Scientific Instruments. J. A. Tomkins (*J. Research Bradford Tech. Coll.*, 1930, **1**, 282–286).—Reprinted from the *Instrument World*, **1925**. The practical importance of the principles of geometric design as enunciated by Thomson and Tait in their treatise on natural philosophy is not generally recognized as it should be. The article deals with this aspect of instrument design as distinct from the purely mechanical aspect. Examples are freely quoted and there is considerable discussion as to the relationships between the degrees of freedom of movement, the degree of restraint, and the generalized co-ordinates.—W. A. C. N.

Scientific Control in Steel and Tinplate Works. C. G. Saltren-Willett (*Swansea Tech. College Met. Soc. Papers*, **1932**, 1–22).—Deals briefly with instruments used for temperature measurement and control, carbon dioxide recorders, draught and pressure gauges for use in tinplate works. Points in the works at which measurements may be taken are indicated.—R. Gr.

The Renarex Apparatus [CO_2 Indicator]. Anon. (*Instrument World*, 1932, **4**, 231–232).—A CO_2 indicator for flue gases, operated by rotation of the vanes of a measuring wheel by a stream of gas moving with high velocity, is described.—J. S. G. T.

VII.—PHYSICAL AND MECHANICAL TESTING AND RADIOLOGY

(Continued from pp. 368–369.)

Laboratory Testing in Relation to Design. Bernard P. Haigh (*Elect. Welding*, 1931, **1**, (2), 3–5).—The limitations of the usual laboratory tests and the value of tests on complete structural units are pointed out. The "triple tensile stress" theory is suggested as an explanation of fatigue failure.
—H. W. G. H.

Study of Stresses by Means of Polarized Light and Transparencies. R. V. Baud (*Proc. Eng. Soc. Western Pennsylvania*, 1928, **44**, 199–232).—The theoretical bases of photo-elastic methods of stress analysis are first briefly stated, and their application to actual models is then described. The discovery of such transparent materials as celluloid and bakelite, which, like glass, are isotropic in the absence of stress and æolotropic when stressed, has made the accurate shaping of models comparatively easy. The determination of isoclinic lines and lines of principal-stress direction is described, and representative types of model are discussed in detail. The importance of stress distribution in both brittle and ductile materials is emphasized. In the discussion stress concentrations near holes and under uniformly distributed loads or under parabolic loading are considered.—P. M. C. R.

Non-Destructive Testing of Welds. Anon. (*Welding J.*, 1931, **28**, 347–348; and *Indust. Gases*, 1931, **12**, 190–192).—Reproduced from *Oxy-Acetylene Tips*, 1931, **10**, 155. See *J.*, this volume, p. 91.—H. W. G. H.

Testing Drawing Qualities of Aluminium Sheets. Robert J. Anderson (*Machinery* (*N.Y.*), 1931, **37**, 494–495).—Representative figures obtained in testing various grades of aluminium sheet over a range of thicknesses in a cupping machine are tabulated. Details of the machine, which contains a hemispherical punch and die, are given. The values recorded are: (*a*) pressure exerted when a cup depth of 0·25 in. is reached; (*b*) pressure at rupture; (*c*) depth of cup at rupture. The rate of travel of the punch has little effect on the results.—J. C. C.

Apparatus for Long-Period Temperature-Stress Tests on Metals. W. H. Hatfield, G. Stanfield, J. Woolman, and N. B. McGregor (*J. Sci. Instruments*, 1932, **9**, 150–153).—In this apparatus a tensile stress is applied to the specimen by means of a single lever machine. The specimen is heated in a Nichrome resistance furnace, the winding being divided into three portions in which the current can be separately controlled. The temperature is controlled by means of a platinum resistance mounted in thin silica tubes arranged along the length of the furnace tube so as to give the average temperature. This resistance forms one arm of a Wheatstone bridge, and relays are worked by the periodic depression of the needle of the indicator. The extensometer is a modification of the Lamb roller type made of high-speed steel. The different parts of the apparatus are illustrated diagrammatically. Uniformity of temperature along the length of the furnace is obtained to within $\pm$ 0·25° C., and the control keeps the temperature steady to within 0·1° C. The extension can be measured at 0·3 millionths per 1 in. of gauge length, and this sensitivity is such that fluctuations in the temperature of the room must be controlled.—W. H.-R.

Piezo-Electric Determination of the Tenacity of Thin Metal-, Glass-, and Quartz-Fibres. F. Seidl (*Z. Physik*, 1932, **75**, 735–740).—A piezo-electric quartz crystal manometer is used to measure the load applied to a fibre by the steadily increasing force experienced by an iron sphere placed in an increasing magnetic field. The limiting load at which fracture occurs can be determined very accurately. The tensile strength of platinum wires of diameter 0·01 mm. was found to be 49 kg./mm.^{2} when the load was slowly and continuously in-

creased. When an interval of 1 minute was allowed to elapse before the load was increased, the tensile strength was found to be increased to 96·08 kg./mm.^{2} With a suddenly applied load, the tensile strength was only 21 kg./mm.^{2}. It is suggested that the method can be applied to more massive test-pieces also.
—J. S. G. T.

On the Determination of Elastic Modulus of Rods by Means of Bending Vibrations. E. Goens (*Wiss. Abhandl. Physikal.-Tech. Reichsanstalt*, 1932, **15**, 231–260).—Reprinted from *Ann. Physik*, 1931, [5], **11**, 649–678; see *J.*, this volume, p. 174.—M. H.

On the Relation between Effective Flow Tension and Hardness. F. Sauerwald and F. Rakoski (*Z. Metallkunde*, 1932, **24**, 94–95).—The strengthening of a working material on deformation is measured by the increase in the effective flow tension. Experiments with low-carbon steel have shown that the fall-hardness, being proportional to the effective flow tension, may be taken as a measure of the strengthening.—M. H.

The Herbert Pendulum Hardness Tester. P. L. Henderson (*Commonwealth Eng.*, 1932, **19**, 289–292).—A description of the construction of the Herbert Pendulum Tester and of its method of use is given. The hardness values given by this instrument and the Brinell hardness numbers are connected by the linear equation: $B = 20(T - 5)$, where B = the Brinell hardness and T = the Herbert diamond hardness. With the steel ball, the equation becomes: $T = 0{\cdot}067B + 7$, where T = the Herbert time-hardness. Curves are given showing the fall in the Herbert hot-hardness of various steels and cast-iron with temperatures within the range 0°–800° C.—J. H. W.

The Avery Hardness Testing Machine. Anon. (*Machinery*, (*Lond.*), 1931, **37**, 555–556).—An illustrated description. This machine measures the depth of penetration of a ball or diamond under loads of 100 kg. or 150 kg. respectively.—J. C. C.

Full-Load Calibration of a 600,000-lb. Testing Machine. H. F. Moore, J. C. Othus, and G. N. Krouse (*Amer. Soc. Test. Mat. Preprint*, **1932**, June, 1–5).—Describes the calibration of a screw-power, balance-beam testing machine of 600,000-lb. capacity. The calibration was carried out by the use of two 10,000-lb. standard weights and an elastic bar fitted with a delicate strainometer. The elastic bar was used merely as a transfer instrument, and it was not necessary to evaluate its elastic constants. All that was necessary was to have a strainometer sufficiently sensitive that the load on the bar could be reproduced a few moments later with a high degree of accuracy. After 27 years of rather severe service the testing machine was found still to have a high degree of accuracy and sensitivity.—S. G.

RADIOLOGY

Gamma Rays and their Uses. Gilbert E. Doan (*Welding Eng.*, 1932, **17**, (1), 31–32).—The application of γ-rays for detecting faults in welds is discussed. Compared with X-rays, they have the advantages of being able to penetrate greater thicknesses, and of greater portability together with the possibility of examining more than one specimen at the same time. On the other hand, X-rays bring out more detail and need shorter exposure times.—H. W. G. H.

Simplification of X-Ray Technique for Large-Scale Investigations by Practical Expedients. W. Grimm and F. Wulff (*Autogene Metallbearbeitung*, 1932, **25**, 66–75).—Examples of X-ray investigation of large and intricate structures are described in order to illustrate the technique recommended. Both visual and photographic methods are used. In the former case, danger to the observer is avoided by viewing the screen through a mirror; in the latter case, flexible film is employed with cassettes of varied size and type, some flexible, to suit the particular case. The screened X-ray tube is preferred to the unshielded type and special emphasis is laid on the need for careful screening of

all stray rays. For small objects, lead powder is recommended for this purpose.—H. W. G. H.

X-Rays as a Research Tool in Chemistry and Industry. George L. Clark (*Indust. and Eng. Chem.*, 1932, **24**, 182–190).—The properties of X-rays which may be applied to research are briefly reviewed. To indicate the status and possibilities of X-rays as a tool, the following fields are discussed, viz.: advances in industrial radiography; recent application of X-ray data to theories of atomic structure; chemical analysis from X-ray spectra; advantages of X-ray analysis; disadvantages of X-ray spectra; crystalline structures of the elements; systematization of iron alloys and other inorganic systems; grain-size measurement in the colloidal range; grain-size measurement in the microscopic range; detection and estimation of internal strain in crystals; practical studies of rolling and heat-treating metals; new methods of studying molecular orientation; shape of molecules; and structures of polymerized natural materials.—F. J.

X-Rays in the Foundry—Elementary Technique. R. Drahokoupil (*Zentral Europ. Giesserei Zeit.*, 1930, **3**, (5), 5–7).—Cf. this *J.*, 1930, **44**, 607. An elementary discussion of the principles of X-rays, their production and use.—W. N.

IX.—ELECTROMETALLURGY AND ELECTROCHEMISTRY

(Continued from pp. 370–372.)

ELECTRODEPOSITION

Throwing Power of Chromium [Plating] Baths. Max Schlötter (*Metallwaren-Ind. u. Galvano-Tech.*, 1932, **30**, 33–34).—As current densities of less than 6 amp./dm.^{2} produce milky chromium deposits and densities of more than 15 amp./dm.^{2}, matt or burnt deposits, it follows that if the anode is relatively small compared with the cathode, that portion of the latter which is directly opposite the anode will tend to develop a matt deposit and the more remote portions of the cathode a milky deposit. Similarly with a flat anode the deposits in deeply recessed parts of the cathode tend to be milky, whilst those on prominences tend to be matt. These effects are due to the irregular current density and relatively poor throwing power of the baths.
—A. R. P.

Anodes and Auxiliary Anodes in Chromium Plating. Richard Justh (*Metallwaren-Ind. u. Galvano-Tech.*, 1932, **30**, 35–36).—Lead anodes with a finely crystalline structure give longer service in chromium-plating baths than do those with a coarsely crystalline structure, hence 6% of antimony is usually added to ensure a fine-grained structure. The ratio of the areas of anode and cathode should be between 1 : 1 and 1 : 2 and it is preferable to use several small anodes rather than a single large one; for deeply recessed articles auxiliary anodes should be placed so that an even deposit is thrown into the deep parts. Steel anodes are not as efficient as lead anodes in oxidizing back to chromic acid the tervalent chromium formed at the cathode.—A. R. P.

The Limits of Rational Current Yield in the Electro-Deposition of Chromium from Chromic Acid Solutions. —— Schöpff and —— Rassow (*Metallwaren-Ind. u. Galvano-Tech.*, 1932, **30**, 36–37).—In a chromic acid plating bath containing 250 grm./litre of chromic acid a maximum current yield of 14% at 10 amp./dm.^{2} is obtained at 42°–43° C. with a sulphuric acid content of 1·1%, but with 0·8% or 1·4% of sulphuric acid the current yield is reduced only to 13%. With 15 amp./dm.^{2} the maximum current yield is 16% with 1·1% of sulphuric acid and 13% with 0·8% and 2% of acid; hence by increasing the current density the sulphuric acid content may be varied within wider limits without reducing the current yield.—A. R. P.

The Protective Covering Layer in Practical Chromium Plating. Heinrich Leiser (*Metallwaren-Ind. u. Galvano-Tech.*, 1932, **30**, 37–39).—A discussion of the relative merits of the exhaustor fan for removing spray from the surface of the bath and the use of a protective layer of oil for preventing the formation of the spray. The former method is preferred.—A. R. P.

Chromium Plating as Surface Hardener. Heinrich Leiser (*Metallwaren-Ind. u. Galvano-Tech.*, 1932, **30**, 58–60).—The use of chromium plating for obtaining a wear-resistant surface on precision measuring instruments and tools is discussed.—A. R. P.

Results of Investigations on Fissure- and Pore-Free Chromium Deposits Prepared in the "Kr" Chromium Plating Bath. P. Hentschel (*Metallwaren-Ind. u. Galvano-Tech.*, 1932, **30**, 106–108).—The "Kr" bath comprises a solution containing 500 grm./litre of chromic acid and sulphuric acid equivalent to more than 1·2% of the chromic acid. With a $CrO_3 : SO_4$ ratio of 100 : 1·7 the current yield at 10 amp./dm.^{2} falls with rise in temperature from 24% at 25° C. to 12% at 40° C. and at 20° C. rises with increase in current density from 11% at 4 amp./dm.^{2} to 26% at 11 amp./dm.^{2}. The bath gives satisfactory deposits up to a $SO_4 : CrO_3$ ratio of 3·5%, but works best at a ratio of 1·7–2·5%. The current yields are 20–50% above those obtained from the older types of plating bath and the deposits have a much smaller content of occluded hydrogen, so that there is less tendency for the formation of fissures and pores. The throwing power is very good and the troubles due to accumulation of iron in the bath are avoided.—A. R. P.

Porosity of Electroplated Chromium Coatings. Anon. (*Brass World*, 1931, **27**, 257).—Reprinted from *Tech. News Bull., Nat. Bur. Stand.*, No. **174**, 1931. A report of the work has since appeared in *U.S. Bur. Stand. J. Research*, 1931, **7**, 697. See *J.*, this volume, p. 32.—S. G.

The Chromium Plating Process for the Most Useful Metals and Alloys. K. Altmannsberger (*Chem.-Zeit.*, 1931, **55**, 817–818).—A discussion of the applicability of chromium plating to common metals and alloys. Intermediate coatings should always be used; the nature of these depends on the metal to be plated and the purpose for which the plating is applied, *e.g.* as a protection against corrosion, to provide a hard surface layer, or to prevent scaling at high temperatures. Rust-resisting coatings on iron are preferably built up by flashing with copper in a cyanide bath, thickening the copper deposit in a sulphate bath, depositing nickel until a total thickness of 0·025 mm. of plating is obtained, and then applying a chromium coat in the usual bath. Aluminium alloys are preferably coated with zinc by simple immersion in a solution of alkali zincate, then plated with nickel from a citrate bath before having the final chromium plate.—A. R. P.

Chromium Plating of Pure Aluminium and Aluminium Alloys. K. Altmannsberger (*Chem.-Zeit.*, 1931, **55**, 709–710).—See *J.*, this volume, p. 177.
—A. R. P.

The Chromium Plating of Light Alloys. K. Altmannsberger (*Chem.-Zeit.*, 1932, **56**, 247).—A zincate solution is prepared by dissolution of 300 grm. of zinc sheet in 5 kg. of hot sodium hydroxide solution to give a solution of *d* 1·26–1·32. The cleaned aluminium article is dipped in this solution at 40°–50° C. until covered with a bright silver-white deposit of zinc, which can then be plated with nickel and subsequently with chromium. The process is especially applicable to the plating of "Y" alloy, Silumin, and "No. 12" alloy.—A. P.

Chromium Plating of Steel for Wear Resistance at High Temperatures and High Current Densities. A. Willink (*Met. Ind.* (*Lond.*), 1932, **40**, 547–549).—Abstract of a paper read before the Electrochemical Society. See *J.*, this volume, p. 96.—J. H. W.

The Removal of [Bath] Fumes in Chromium Plating. Anon. (*Z. ges. Giesserei-Praxis*: *Das Metall*, 1932, **53**, 168–169).—The method of removing fumes from the bath and chromium plating is described.—J. H. W.

Gold-Plating Baths. H. Krause (*Mitt. Forsch. Inst. Edelmetalle*, **1931**, 25–30, 49–55; *C. Abs.*, 1932, **26**, 2379).—A general discussion of the composition of gold-plating baths and of the conditions under which the plating should be carried out.—S. G.

The Electro-Deposition of Nickel and Chromium. J. W. Cuthbertson (*Metallurgia*, 1932, **6**, 15–16).—A description of the changes in the technique of commercial electroplating brought about by the introduction of chromium plating deals with a description of the plant required to obtain an increased output and a better quality of product. The types of vats used, wood lined with lead for nickel and iron vats for chromium, and the methods of heating such vats by steam, gas, or electricity are dealt with. Consideration is also given to methods for agitating and filtering the plating solutions; to the movement of cathodes either by moving the work continually in one direction through the solution, or by using a reciprocating motion; and to the types of anodes used for nickel and for chromium plating.—J. W. D.

Modern Nickel Plating. H. Kurrein (*Chem.-Zeit.*, 1932, **56**, 93–94, 114–115).—A review of recent developments in the nickel plating industry with especial reference to the low p_H bath and the use of hot concentrated solutions of nickel salts.—A. R. P.

Nickel Plating Aluminium. Anon. (*Bottler and Packer*, 1932, **6**, (6), 70–71).—Practical operating details are given. A brass anchor deposit is used. —H. W. G. H.

The Calcium Fluoride Method for the Determination of Fluoride with Special Reference to the Analysis of Nickel Plating Solutions. S. G. Clarke and W. N. Bradshaw (*Analyst*, 1932, **57**, 138–144).—A 10-c.c. sample of the plating bath is diluted to 25 c.c., boiled with 5 c.c. of ammonia, and filtered; the filtrate is acidified with hydrochloric acid, treated with 2·5 c.c. of 10% calcium chloride solution, then with ammonia until just alkaline, boiled, cooled, and filtered. The precipitate of calcium fluoride is washed with a solution containing 5% of ammonium nitrate and 1% of acetic acid, ignited at 700°–800° C., and weighed; it is then repeatedly evaporated with hydrochloric acid in a platinum dish until the fluorine is expelled and its calcium sulphate content determined by precipitation with barium chloride, calcium fluoride being obtained by deducting this weight from the first.—A. R. P.

The Control of Electrodepositing Solutions. XII.—The Silver Solution. Samuel Field (*Met. Ind.* (*Lond.*), 1932, **40**, 499–500).—Cf. this *J.*, 1931, **47**, 666; this volume, p. 250. The methods of estimating the free cyanide, silver content, and carbonates in the solution used for silver-plating are described, and the removal of carbonates with barium cyanide and the evaluation of this salt are discussed.—J. H. W.

Faults in Silver Plating; Their Cause and Prevention. Anon. (*Metallwaren-Ind. u. Galvano-Tech.*, 1932, **30**, 83–85).—Practical hints on the correct operation of silver plating baths.—A. R. P.

Comparison of Electrodeposits of Zinc and Cadmium from the Point of View of the Protection of Steel against Corrosion. H. Figour and P. Jacquet (*Compt. rend.*, 1932, **194**, 1493–1495).—The results are given of a large number of systematic investigations undertaken with the idea of determining the best conditions for the use of the 2 types of coating. The electrodeposits were made on plates of Thomas steel (0·063% carbon), the preparation of the specimens before deposition, the composition of the baths (15 formulæ were tried), and the conditions of electrolysis being varied. The coated specimens were subjected to 3 sorts of corrosion: (*a*) salt spray test (25 grm./litre at 15°–20° C.); (*b*) warm and wet atmosphere; (*c*) ordinary atmosphere. The extent of corrosion was measured (1) by the time of exposure after the rust appeared; (2) the variation in weight of the specimen as a function of the time of exposure.

The results showed that in the case of tests (*a*) and (*b*), cadmium is a better protector than zinc, but that in the case of test (*c*), zinc is the more resistant.
—J. H. W.

The Electrodeposition of Alloys.—I. L. B. Hunt (*Metallurgist* (Suppt. to *Engineer*), 1932, **8**, 52–53).—A review, dealing with available knowledge of the principles of simultaneous deposition of two or more metals from a mixed solution, and of the effects of variables.—R. G.

Electroplating [on] Aluminium as Production Basis Practicable with Process Control. W. S. McArdle (*Automotive Ind.*, 1932, **66**, 98–99, 110).—Commercial electroplating on aluminium is possible if the surface of the metal is first thoroughly cleaned, and subsequently etched sufficiently deeply to provide adequate anchorage for the plated coating. Cleaning and roughening methods are described, with times of immersion and ingredients of bath. Special precautions in applying various types of metallic coating to aluminium, and rapid methods of testing the coating, are described.—P. M. C. R.

Electroplating on Aluminium from Cyanide Solutions. Harold K. Work (*Metal Cleaning and Finishing*, 1931, **3**, 729–732; *C. Abs.*, 1932, **26**, 34).—See this *J.*, 1931, **47**, 550.—S. G.

The Manufacture of Phonographic Records. R. A. Dimon (*Monthly Rev. Amer. Electroplaters' Soc.*, 1932, **19**, (1), 7–13; discussion, 13–16).—An interesting account of modern practice in the manufacture of gramophone records.
—A. R. P.

Tensions of Electrolytic Deposits of Metals. C. Marie and N. Thon (*J. Chim. Phys.*, 1932, **29**, 11–17).—The deposit of copper obtained from a solution containing 200 grm./litre of copper sulphate, electrolyzed with a current density of 1·1 amp./dm.^{2} and a cathode of bright platinum, gold, silver, or copper, undergoes expansion. The same deposit on a platinized platinum cathode undergoes contraction. In a similar solution with the addition of 1% sulphuric acid the deposit on platinum or copper cathodes contracts; expansion is observed at first on cathodes of silver or gold, but finally the deposit contracts. Contraction is observed always when the solution contains 2–3% of sulphuric acid. When copper is deposited from a solution of cuprous chloride in hydrochloric acid or in sodium chloride, expansion is always observed. The addition of a trace of hydroxylamine to a solution of cupric sulphate suffices to transform the contraction of the deposit into an expansion. Expansion is always observed in deposits of zinc, whether from the sulphate, chloride, or complex cyanide.—E. S. H.

Practice in Electroplating Apparatus. Hans Hornauer (*Anz. Berg., Hütten-u. Masch.*, 1931, **53**, (53), 3–4).—B. Bl.

Deposition of Metals by Electrolysis Starting from Non-Aqueous Solutions. L. F. Audrieth and H. W. Nelson (*Light Metals Research*, 1931, **1**, (21), 11).—See this *J.*, 1931, **47**, 665.—J. C. C.

ELECTRO-REFINING, &c.

Electrolytic Refining of Aluminium and Aluminium Deposition in the System $AlCl_3$.NaCl. V. A. Plotnikov, V. P. Machovetz, and N. S. Fortounatov (*Light Metals Research*, 1931, **1**, (17), 4).—An abstract from *J. Khim. Promishlenosti*, 1930, **7**, (24). Using a bath having a composition between $NaCl.2AlCl_3$ and $NaCl.1{\cdot}5AlCl_3$, coherent deposits of aluminium could not be obtained in greater thicknesses than 0·05 mm., either by altering the temperature, using revolving cathodes, or adding different salts and organic substances. Non-coherent crystals of aluminium were, however, obtained without the separation of iron provided the anodes contained less than 36% of iron and the current density was below 5 amp./dm.^{2}. On increasing the current density to 50 amp./dm.^{2}, the deposit became grey and spongy. The crystals of aluminium were

separated and melted, yielding refined aluminium containing 0·04–0·06% of iron and 0·26% of silicon, and characterized as very resistant to acids.
—J. C. C.

The Development of Electrolytic Methods of Metal Refining at the Norddeutsche Affinerie in Hamburg. W. Schopper (*Metallgesellschaft Periodic Rev.*, 1932, (6), 29–39).—[In English.] A historical summary is first given. The multiple system of copper refining using acid copper sulphate solution as electrolyte is employed. For silver the Moebius process and for gold the Wohlwill process is used. A description is also given of the electrolytic bismuth plant.—W. A. C. N.

The Production of Zinc by Electrolysis.—II. Harry Hey (*Chem. Eng. and Min. Rev.*, 1932, **24**, 197–205).—A comparison is made of the methods employed at Anaconda, Trent, and Risdon for the production of zinc from zinc solutions by electrolysis, and details are given of the electrolytic plant, solutions, materials, and the methods of melting and casting the cathode zinc and the residues.—J. H. W.

ELECTROCHEMISTRY. GENERAL

The Metals in Electrochemistry. Louis Kahlenberg (*Science*, 1931, **74**, 79–82).—Verbatim report of the Presidential Address to the Electrochemical Society. See *J.*, this volume, p. 100.—W. H.-R.

The Hydrogen Overvoltage of Cadmium. Håkon Flood (*Kgl. Norske Videnskab. Selskab Forh.*, 1930, **B 3**, 112–115; *C. Abs.*, 1931, **25**, 5611).—When current–potential curves for cadmium against a hydrogen electrode in sulphuric acid solutions were extrapolated to zero current, values for the potential of cadmium were obtained as follow: in 0·01*N* sulphuric acid, 0·36 v.; 0·1*N*, 0·41 v.; 1*N*, 0·46 v.; 2*N*, 0·48 v., and 10*N*, 0·53 v. These values correspond with definite amounts of cadmium ions in solution and account for anomalous overvoltage values.—S. G.

On the Activity Coefficients of the Lead Halides and the Normal Potential of Lead. Hans Fromherz (*Z. physikal. Chem.*, 1931, [A], **153**, 376–390).—Previous values for the normal potential of lead vary from $E_0 = 0{\cdot}122$ to 0·1297 v. A recalculation of the results of some of these workers, taking into account the recently determined activity coeff. and state of association of lead halides, gives the concordant value of $0{\cdot}1274 \pm 0{\cdot}0001$ v.—B. Bl.

Electrolytic Investigations of Zinc Single Crystals. Karl Heinz Kreuchen (*Z. physikal. Chem.*, 1931, [A], **155**, 161–198).—The potential of single crystals of zinc in zinc sulphate solutions is positive with respect to polycrystalline zinc immediately after immersion in the solution, but the ideal single-crystal surface is slowly destroyed in time by the addition or removal of atoms, so that its potential gradually approaches that of the polycrystalline metal. The initial potential of the base of the single crystal decreases rapidly at first, then increases again, but the equilibrium potential is attained slowly; the same effect is observed when the zinc single crystal is opposed to a copper, a polycrystalline zinc, or to a cadmium amalgam, electrode. Single crystals of zinc have been satisfactorily grown in a zinc sulphate solution containing boric acid with a current of 0·006–0·017 amp./ cm.^{2}, the rate of growth being 12–34 molecular layers per second. Current measurements have been made in capillary cells with electrodes of single crystal zinc.—B. Bl.

Electrochemical Periodicities. J. A. V. Butler and G. Armstrong (*Nature*, 1932, **129**, 613–614).—Periodic changes of potential have been observed at the anode in the electrolysis of dilute sulphuric acid saturated with hydrogen, using platinum electrodes. Potentials at which oxygen is liberated were not reached.—E. S. H.

Transference Number of Cobalt Sulphate. R. C. Cantelo and E. C. Payne (*J. Physical Chem.*, 1932, **36**, 1045–1050).—The transference number of cobalt ion in cobalt sulphate solutions of concentrations 0·233*N* to 3·994*N* is found to range from 0·396 to 0·149. The value calculated from the ion conductance is 0·419 for solutions of zero concentration. The formation of complex anions of the type $Co(SO_4)_2$ is suggested to explain the experimental results.—J. S. G. T.

Theory of Electrolytic Valve Action. A. Günther-Schulze (*Z. Physik*, 1932, **75**, 143–144).—G. replies to Müller's adverse criticism of his work on this subject (see *J.*, this volume, p. 101).—J. S. G. T.

X.—INDUSTRIAL USES AND APPLICATIONS

(Continued from pp. 373–382.)

Bearing Metals. Christopher H. Bierbaum (*Tin*, **1932**, April, 3–4; and *Iron Age*, 1932, **129**, 774–776, 817).—Abstracts of a paper read at a Conference on Metals and Alloys at Cleveland, U.S.A. See *J.*, this volume, p. 179.
—J. H. W.

Results of the International Competition 1931 for the Development of the Use of Aluminium and its Alloys. Anon. (*Hauszeit. V.A.W. u.d. Erftwerk A.G. Aluminium*, 1932, **4**, 43–69).—An interesting report which gives details of a large number of proposals for increasing the consumption of aluminium and its light alloys especially in industrial applications, *e.g.* architecture, tanks, transport apparatus, traffic, free transmission cables, leather industry, radiators for central heating, &c.—M. H.

Cooking Food in Aluminium Vessels. Anon. (*Metallurgia*, 1932, **6**, 33).—A review of recent work carried out to determine the suitability of various metals for the construction of cooking utensils and food containers shows that only barely detectable amounts of aluminium appear in the tissues following diets containing large amounts of aluminium and that the aluminium content of the general run of aluminium-cooked foods is so small as to be of no significance. Clean aluminium utensils are attacked to an insignificant degree by foods of neutral reaction, whilst acid foods or foods to which baking soda has been added dissolve only very small amounts of aluminium. Dark utensils yield more aluminium to food than bright ones, and sugar decreases corrosion of aluminium vessels.—J. W. D.

Oxwelded Bodies. Anon. (*Oxy-Acetylene Tips*, 1932, **11**, 51–55).—Railway and motor tanks, fabricated by oxy-acetylene welding aluminium and its alloys, are illustrated and described. Not only is a great saving in weight effected, but also the strength is often greater than that obtained by other methods of construction, and the risk of corrosion is greatly decreased. Gasoline, oil, milk, syrup, glacial acetic acid, and other chemicals are transported in these tanks.—H. W. G. H.

Notes on Aluminium Alloy Pistons. F. A. W. Livermore (*Met. Ind.* (*Lond.*), 1932, **40**, 513–514).—The advantages of light alloy pistons are: (1) low friction and inertia owing to their lightness; (2) lower mean temperature of oil film between the piston and the cylinder walls. Less oil is thus required without risk of seizure; (3) no carbonization of oil on the underside of the crown owing to its lower temperature. A suitable alloy must have high enough strength to withstand shocks, high thermal conductivity, a coeff. of expansion comparable with that of iron, be capable of resisting wear throughout the required temperature range, and be easily compounded and worked. The manner in which aluminium alloys fulfil these requirements and data in piston design are discussed.—J. H. W.

Light Alloys in Aircraft. H. W. Gillett (*Heat-Treating and Forging*, 1932, **18**, 98–101).—Abstract of a paper read before the Conference on Metals and Alloys, Case School of Applied Science.—J. H. W.

Aluminium Alloy Motor Boats. Anon. (*Motor Boat*, 1932, **56**, 512–513).—A description of two 16-knot, 40-ft. single-screw dispatch launches proposed for service in South American waters. The hull, fuel tanks, and the whole of the superstructure, as well as deck fittings such as bollards, fairlights, deck plates, and ventilators, are to be constructed of a sea-water-resisting aluminium alloy.—J. W. D.

Aluminium Castings have Advantages as Work-Holding Racks. Anon. (*Machinery* (*N.Y.*), 1931, **37**, 435).—Work racks made of aluminium castings combine strength with lightness.—J. C. C.

Seamless Aluminium Hose. Anon. (*Chem. and Met. Eng.*, 1932, **39**, 105).—This flexible seamless aluminium hose of 1-in. inside diam., recommended for use in handling nitric acid, is made of helically corrugated, specially tempered aluminium and is provided with solderless and packless Duralumin end-couplings, the exterior being protected by strong, closely-wound aluminium wire.—F. J.

Metal Insulation as Protection against Cold. Hans Niemann (*Apparatebau*, 1931, **43**, 289–293).—Discusses the application of aluminium foil as heat insulator; see abstract from a paper by E. Schmidt, this *J.*, 1928, **40**, 652.—M. H.

Metallic Heat Insulation. Anon. (*Chem. and Met. Eng.*, 1932, **39**, 102).—Resistance to heat transference, equal to that of the best cork, is said to be obtainable with an insulating material made of aluminium foil, which has recently been introduced into U.S.A. by the Alfol Insulation Co., Chrysler Building, New York City, U.S.A. "Alfol" insulation made up of successive layers of the foil either held apart by insulating separators or by crumpling the foil, stood up indefinitely to severe vibration, was moisture-proof, vermin-proof, and resistant to industrial fumes and vapours.—F. J.

Aluminium Inks. J. H. Meyer (*Amer. Ink Maker*, 1931, **9**, (7), 21–22, 37; *C. Abs.*, 1931, **25**, 5582).—Success in aluminium ink printing is attained when (1) an extra fine grade of aluminium powder is used; (2) excessive working of the ink on rolls and plate is avoided; (3) the vehicle and powder are mixed shortly before using; (4) the accumulation of ink on the rollers is prevented; (5) no forced drying is resorted to; (6) smooth paper is used, and (7) the design calls for large areas of aluminium and no fine lines or type.—S. G.

A New Factor in Jewellery—Aluminium. Anon. (*Brass World*, 1932, **28**, 67–69).—Some of the more important applications of aluminium for articles of jewellery are outlined.—J. H. W.

Aluminium as Fuel. Anon. (*Light Metals Research*, 1931, **1**, (17), 7–8).—Extracted from *Indian and Eastern Eng.*, 1931, **68**, 563. See *J.*, this volume, p. 103.—J. C. C.

Beryllium. Anon. (*Mineral Ind.*, 1931, **39**, 653).—The high price of beryllium hinders the development of commercial applications. The sources at present known are not sufficient to maintain production on an extensive scale.—E. S. H.

The Photoelectric Properties of Films of Beryllium, Aluminium, Magnesium, and Thallium. H. de Laszlo (*Phil. Mag.*, 1932, [vii], **13**, 1171–1178).—Beryllium and aluminium are found to be not specially useful for the construction of photoelectric cells owing to their low efficiency and to the fact that their spectral sensitivity is covered by that of the more efficient magnesium. Thallium, although very insensitive, might be of use for certain purposes; it is responsive to the ultra-violet and cuts off sharply at 3400 A. Magnesium is very suitable for the construction of ultra-violet photoelectric cells. Its efficiency between $\lambda\lambda$ 2800 A. and 2400 A. is exceptionally high, and it can be used down to λ 4000 A. Cells having any desired spectral sensitivity distribution can probably be constructed by the use of magnesium-lithium alloys.—J. S. G. T.

Bismuth. Anon. (*Mineral Ind.*, 1931, **39**, 653–654).—Statistics of world production are given. A new development is the production of extruded bismuth wire in lengths up to 20 ft. and 0·012, 0·025, and 0·031 in. in diam.
—E. S. H.

Cadmium. Anon. (*Mineral Ind.*, 1931, **39**, 655–656).—The cadmium output of the world continues to increase, the most important cause being its use in electroplating. Considerable amounts of the metal are also used in making fusible alloys.—E. S. H.

Cæsium and Rubidium. Anon. (*Mineral Ind.*, 1931, **39**, 657–658).—Both cæsium and rubidium are used for obtaining high vacua for radio valves. Rubidium is more suitable than cæsium for the manufacture of photoelectric cells, because a thinner layer can be deposited on the inside of the glass.
—E. S. H.

Cerium. Anon. (*Mineral Ind.*, 1931, **39**, 657).—Both cerium and ferro-cerium have outstanding properties, which will result ultimately in extensive commercial demands. Ferro-cerium is pyrophoric and is used in pocket-lighters and similar devices. Attempts to use the alloy in the form of wafers for obtaining high vacua in radio tubes have been abandoned. A new use has been developed for cerium metal as a gas purifier in connection with the manufacture of neon lamps.—E. S. H.

The Application of Copper and its Alloys in Buildings. Anon. (*Cuivre et Laiton*, 1932, **5**, (73), 77–82; (74), 103–112).—A description of buildings, in various parts of which copper construction has been effectively used. It is stated that this metal is very acceptable on account of its relatively great resistance to corrosion and its ability to assume a pleasing patina. The article is illustrated by some remarkably fine photographs of ornamental doors to important buildings in various cities of the world. Copper has only recently been introduced for window casements, but is finding extensive applications. Other uses to which the metal has been put are in the manufacture of gutters, flashings, ventilators, radiators, weather vanes, and in interior decoration.
—W. A. C. N.

A Copper-Coated Building. Anon. (*Met. Ind.* (*Lond.*), 1932, **40**, 456).—A brief description of "Vesterport," a building in Copenhagen entirely covered with copper, nearly 110 tons of the metal being used.—J. H. W.

Copper in the Construction of Mixing Machines. A. Chaplet (*Cuivre et Laiton*, 1932, **5**, (75), 137–138).—A brief description of several types of machines which are used in industry and for which, it is suggested, copper is a suitable material.—W. A. C. N.

Fourdrinier Wires and Cloths. Kurt Jahn (*Wire and Wire Products*, 1932, **7**, 107, 109, 110, 127–130).—A description is given of the various weaves of wire cloth used in paper-making. The wires used are chiefly copper alloys, including phosphor-bronze, Tombac, and Monel metal, sometimes tinned or lead-coated.—J. H. W.

Lead Tubes, Mantle Tubes, and Copper Tubes as Water Pipes in Houses. Anon. (*Apparatebau*, 1931, **43**, 293–295, and *Z.V.d. Kupferschmied.*, 1931, **43**, 271–274).—The superiority of copper tubes over those of lead and lead with an inner coating of tin is emphasized.—M. H.

Lithium. Anon. (*Mineral Ind.*, 1931, **39**, 658).—Lithium possesses valuable hardening properties when added in small quantity to other metals or alloys, especially aluminium, aluminium alloys, lead, and lead–tin alloys. Lithium–lead alloys are replacing lead–tin bearing metals. Electrolytic lithium (99·7%) is available commercially, but its applications have not yet been developed. A suggested use is in the purification (degasification) of nickel, iron, and copper, for which lithium is particularly efficacious.—E. S. H.

XI.—HEAT-TREATMENT

(Continued from p. 382.)

The Heat-Transfer to Non-Ferrous Metals in the Annealing Furnace. G. Wagener (*Z. Metallkunde*, 1932, **24**, 35–39).—The heat transfer to aluminium, copper, and brass has been studied in gas- and oil-fired furnaces (laboratory experiments) and electric muffles (works experiments). The coeff. of heat transfer of these metals is considerably below that of iron owing to the smaller absorption of radiant heat at the bright surface of the non-ferrous metals. The coeff. of heat transmission of aluminium, copper, and brass is $\alpha = 0{\cdot}038 (T_0/100)^3 + 10$ kg.-cal./m.^{2}/hr./° C. (T_0 being the furnace temperature in ° abs.) against $\alpha = 0{\cdot}09(T_0/100)^3 + 10$ kg.-cal./m.^{2}/hr./° C. for iron.—M. H.

Bright Annealing of Metals with Hydrocarbon Gases. E. G. de Coriolis and R. J. Cowan (*Indust. and Eng. Chem.*, 1932, **24**, 18–20).—When brass is heated, the surface becomes tarnished, even in nitrogen, owing, presumably, to the liberation of occluded gases, which, being oxidizing in character, form a surface scale, consisting of zinc oxide, or a mixture of oxides. At the desired annealing temperature, zinc begins to volatilize from the brass and, being coincident with the liberation of occluded gases, increases the difficulties in the way of "bright annealing." Experiments are described in which brass wire was caused to travel at a controlled rate through a tube furnace in which hydrocarbon gases were introduced at controlled speeds and temperatures. When the gases travelled counter to the direction of travel of the metal, the latter oxidized, and when in the same direction, there was a danger of air, indrawn with the metal, causing oxidation at a later stage. By preheating the gas to 677° C. before coming into contact with the metal, tarnishing was avoided, a pronounced cracking of the gas resulting in precipitation of carbon and production of hydrogen. These conditions must be met, in order to obtain a surface brilliant in lustre and superior to its original condition. In pure hydrogen, tarnishing occurs at low temperature, *e.g.* 427° C., but not at higher temperature, *e.g.* 650° C. At this temperature, the metal is over-annealed for certain purposes, but this can be avoided by preheating the hydrogen to, say, 677° C., whereafter it can reduce metal oxides readily at lower temperatures. Owing to the explodibility of hydrogen and zinc losses by volatilization, hydrocarbon gases are preferred for industrial annealing processes, and are being developed.—F. J.

Controlled Atmospheres for Annealing and Welding. J. F. T. Berliner (*Metal Progress*, 1932, **21**, (4), 39–43).—Dissociated ammonia is claimed to eliminate scale, and consequent expensive cleaning, by the use of the bright-annealing process with controlled atmosphere. Hydrogen brazing, moreover, is more successfully carried out in dissociated ammonia than in hydrogen alone, and welding of the atomic arc, shielded arc, gas, and lead burning types is advantageously performed with the ammonia mixture. Aluminium is particularly adapted to such welding. The mixed gases have also been used as cutting fuel. Other applications are enumerated, and method and equipment are described and illustrated.—P. M. C. R.

Furnaces Placed in Production Lines. Gordon T. Williams (*Metal Progress*, 1932, **21**, (2), 27–31).—Decentralized heat-treatment units, placed at suitable points in a continuous production plant, are rendered possible by modern conveyor systems, and effect economy together with increased production where interchangeable parts are required. Machining, heat-treatment, and fitting are thus performed with fuller co-ordination and greater economy of staff than are possible with a central heat-treating plant.—P. M. C. R.

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XX.—BOOK REVIEWS

(Continued from pp. 408–416.)

A Treatise on Photo-Elasticity. By E. G. Coker and L. N. G. Filon. Imp. 8vo. Pp. xviii + 720, with 14 plates and numerous illustrations in the text. 1931. Cambridge: at the University Press. (50*s.* net.)

As long ago as 1816 Sir David Brewster showed that an isotropic glass may become doubly refractive under stress, and suggested that from such effects in glass models the stresses in actual engineering structures might be determined. It is apparently to Mesnager, however, that the credit is due for the first, really satisfactory attempt to use photo-elastic methods in engineering research and even for much of the technique which has since been adopted. The rapid growth of photo-elasticity as a distinct subsection of physical science commenced, however, with the introduction of the much more convenient celluloid as the experimental material in place of the glass. For this one of the present authors is responsible, whence to him in large measure the credit for the advances made in this field must be ascribed.

In so far as the engineer is the consumer of metallurgical products, all the results which have been obtained from photo-elastic researches which are of importance in engineering practice are of significance to the metallurgist. Much of the work done is, however, of immediate metallurgical appeal. In the field of mechanical testing, for instance, such investigations have proved highly informative. As examples one may mention the very full examination which has been made of the distribution of stress in tensile test-pieces of varying shapes, especially near the ends, and of the effect of various types of notch in impact test-pieces. The enormous concentration of stress at the root of a crack and around holes (even if the latter are loosely filled with inclusive matter) are of importance in connection with the propagation of cracks—fatigue and otherwise—and of estimating the harmful effect of inclusions. As instances of the more practical type of question which has been considered, the machining operation in a lathe, the stresses set up in service in laminated springs and welded joints, and those due to shrinking a tyre on to the wheel centre may be cited. There is in fact scarcely any branch of mechanical engineering in which this method of investigation cannot throw some new light, and the reviewer has, in conjunction with Mr. J. Barton, applied it to the problem of the stresses set up during the passage of metal through a wire-drawing die.

Turning to the book itself, it deals first, and in considerable detail, with the fundamental optical theory involved and with the pertinent portions of the mathematical theory of elasticity. In both of these sections the demands made on the mathematical equipment of the reader are by no means inconsiderable. Attention is then given to the methods of investigation and to an account of the problems which have been attacked. The treatment throughout is most complete, and to all concerned with such research the volume can be recommended without reservation. It contains everything that is necessary for the application of photo-elasticity as a method of research. The diagrams and colour illustrations are most excellent and, considering the inherent difficulties of the subject, the exposition is admirably clear. Since the authors more than anyone have been responsible for the main advances in this sphere of work, this is not surprising.

As a whole, however, it is not a book for the ordinary metallurgical reader. The treatment, from its very completeness, necessarily demands a considerable knowledge of both physics and mathematics. It is of interest that in the preface the authors mention that it was their original idea to prepare a much more concise treatise, presumably for the benefit of those who wish to use the method simply as a tool, and who were without the time or inclination to devote to it a more complete study. It is to be hoped that this initial intention will not be forgotten. There is still room for the "workshop handbook."—F. C. Thompson.

Chemische Technologie der Neuzeit. Begründet und in erster Auflage herausgegeben von Dr. Otto Dammer. In Zweite erweiterter Auflage, bearbeitet und herausgegeben von Franz Peters und Herm. Grossmann. Fünf Bände. 2er Band, 1er Teil. 4to. Pp. xvi + 876, with 607 illustrations. 1932. Stuttgart: Ferdinand Enke. (Geh. R.M. 75; geb. R.M. 79.)

The new edition of Dammer's treatise on modern chemical technology is to consist of five volumes. Of these the second volume, dealing with metals, is divided into two parts; it is the first of these parts which is at present under review; the second part is to appear early in 1933, and, since Volumes IV and V are announced for the present year, the whole of this monumental work will then be complete. It is greatly to be regretted that the General Editor, Professor Dr. Franz Peters, has not lived to see the completion of the series.

Although officially described as being only a part of a volume, the weighty compilation under review consists of 876 large pages, and is subdivided into three sections, contributed by three different authors. Of these, the first section is devoted to "Metall- und Legierungskunde," the author being Professor von Schwartz, whose work at Munich on the use of polarized light in metallography has aroused so much interest of late years; a beautiful coloured plate showing oxide-inclusions in copper serves to illustrate this method, to which the author, with excess of modesty, devotes only a single page in the text. The first 40 pages deal with the microstructure of metals, cast, deformed, and annealed, with rather more emphasis on facts and less emphasis on causes than is commonly met with in works on physical metallurgy. A brief discussion of mechanical and thermal properties is followed by a detailed treatment of the binary alloy systems, 145 equilibrium diagrams being reproduced, by permission, from Landolt–Börnstein's Tables; this feature would have been even more valuable if the diagrams had been brought up to date so as to include the results of recent research work. The ternary diagrams receive only general treatment, supplemented with a table of references extending to the year 1926. After discussion of several physical properties, there follows a detailed account of the principal classes of commercial metals and alloys, with typical analyses of the various trade descriptions. This portion, which occupies 119 pages, terminates with an alphabetically arranged glossary of important alloys—a convenient key to the composition of some of the new alloys which, disguised under various trade-names, have appeared in such numbers on the market in recent years. Professor von Schwartz's section contains information not easily accessible elsewhere, and will frequently be consulted for reference purposes.

The next section, contributed by Professor von Hagen, of Barmen, is entitled "Oberflächenschutz der Metalle, Metallfärbung, Galvanoplastik." It is clearly the deposition of metallic coatings which interests the author, and the pages devoted to tin and zinc coverings, and also the discussion of metal-colouring, deserve detailed study from those whose interest in these matters is technological rather than scientific. Actually half the author's space is given to the three subjects mentioned; the general subject of corrosion, with its prevention by painting, or by the use of special alloys, receives comparatively brief treatment. There are numerous references to the literature where further details of these matters can be obtained, but, in many cases, they indicate not the original papers, but abstracts in such journals as *Stahl und Eisen*. Moreover, with very few exceptions, they relate to years not later than 1928; even the tables headed "Neue Literatur" refer to papers published in 1927 and 1928; in a rapidly developing subject, such papers are not suitable matter for the "Stop-press Column." There is much important information in Professor von Hagen's contribution, but the impression is unavoidable that parts of it were written several years ago. This is probably no fault of the contributor, and indeed the delay may be partly due to the death of the General Editor. But the time-lag must raise in the reader's mind the general question as to whether the "Omnibus Volume" is most suited to the needs of the present day; science and technology are developing so fast, that such volumes usually contain some section which is out-of-date on the day of publication; and usually it is the most punctual contributors who suffer from the tardiness of their collaborators.

The author of the third section, which is devoted to "Die Vorbereitung der Erze zur Verhüttung," is the late Professor Dr. Franz Peters. There could be no finer memorial to the knowledge or industry of the General Editor than this detailed discussion of an intricate subject. The section, which consists of 380 pages, and is freely illustrated with diagrams showing plant for ore-dressing or other purposes, will fill a real need. The author's outlook is a broad one, and—in contrast with the two earlier sections—full attention is devoted to developments outside Germany, and indeed outside Europe. Although few will attempt continuous reading of the whole section, any metallurgist who has concern with some particular part of the subject will find it treated in an interesting and satisfying manner. The subjects discussed include the dry processes for the preliminary treatment of ores, such as grinding and sieving; wet processes, including details of the innumerable forms of classifiers, settling plant, shaking-tables, and similar devices; flotation processes, which are discussed in the greatest detail, an elaborate glossary of the chemicals employed being included at this point; magnetic processes; electrostatic processes; and various auxiliary matters such as pumps, driers, and the like. The author

then passes on to calcining and roasting, and the numerous forms of mechanical roasters are described in turn, with due attention to the distinctions between the early and later models produced by a single designer.

The publishers have done their work well, the printing being clear and the diagrams—which are mostly introduced into the text instead of being separated as "plates"—are satisfactorily reproduced. The work should be made available in every technical or scientific library.

—U. R. EVANS.

Beryllium: its Production and Application. Published by the Zentralstelle für Wissenschaftlich-Technische Forschungsarbeiten des Siemens-Konzerns. Translated by Richard Rimbach and A. J. Michel. (Scientific Publications of the Siemens Company.) Med. 8vo. Pp. 331, with 198 illustrations. [1932.] New York: The Chemical Catalog Co., Inc. ($10.00.)

The *Wissenschaftliche Veröffentlichungen aus dem Siemens-Konzern* appear three times a year in the form of a journal and contain the results of various scientific investigations carried out by the research staff of Messrs. Siemens & Halske, Siemenstadt, Berlin. Part I of Volume 8, 1929, of this publication was devoted entirely to beryllium, its production and applications, and contained twenty-three individual papers (already abstracted in this *Journal*), on the various aspects of the subject, by different authors, together with an introduction by Alfred Stock, who, in 1919, in collaboration with Hans Goldschmidt, originated the work which has since developed so rapidly in Germany, England, and America.

The present book is an English translation of the German publication mentioned above. It has been produced by arrangement with Messrs. Siemens & Halske and their publishers, and the translators have been given every facility, of which they have taken full advantage, the illustrations, for instance, being beyond reproach. Both paper and printing are excellent. One feels perhaps that the price is somewhat high, although to anyone seriously interested in the modern developments of the metal and its industrial applications, the wealth of information in its pages is immense.

The papers themselves cover a remarkably wide field and deal with the occurrence and distribution of beryllium ores, their extraction, historical summaries of previous attempts to prepare the metal, full details of the present Siemens & Halske method of commercial production, physical and chemical properties of beryllium, its analytical chemistry, the production and properties of its alloys with copper, nickel, iron, aluminium, and silicon, together with several other papers on such subjects as age-hardening, electrical conductivity, &c., of the beryllium-copper alloys. The author and subject indexes, which do not appear in the original, seem to have been carefully and fully compiled. The translators are in no way responsible for the statements contained in the original publications, the truth of some of which one may perhaps feel inclined to question, but such criticisms scarcely come within the scope of the present review. It may be remarked, however, that the translation is accurate, the style lucid, and one is impressed by the care which the authors have bestowed on their work.

—H. A. SLOMAN.

Bronze und Rotguss. Über Eigenschaften, Verwendung, und Bewährung der genormten Bronze- und Rotgusslegierungen nach DIN 1705. Bericht über die Tagung des Fachausschusses für Werkstoffes im V.D.I. von 27 Okt., 1930. (DIN A 5.) Med. 8vo. Pp. vi + 100, with 33 illustrations in the text. 1931. Berlin: V.D.I.-Verlag, G.m.b.H. (R.M. 7.)

A collection of contributions by various authors to a V.D.I. symposium on bronze and red brass. There are three principal sections in the book. The first refers to the technology of bronze and red brass—composition, structure, the influence of secondary cooling on the structure, chemical and physical properties, mechanical properties, range of utility; standard alloys and the development of the standard specifications of DIN 1705; use of the alloys; experiences of users of these materials under various conditions. In a final chapter the recent developments in the production and employment of bronze and brass are reviewed. The reports of the discussions after each section are not the least valuable parts of the book.—W. A. C. NEWMAN.

Engineering Materials. By Arthur W. Judge. Volume II: **Non-Ferrous Metals and Organic Materials.** Being a thoroughly revised edition of "Aircraft and Automobile Materials (Non-Ferrous)." Demy 8vo. Pp. xi + 822, with 268 illustrations. 1932. London: Sir Isaac Pitman and Sons, Ltd. (40*s*. net.)

This book is the second volume of a series of three published under the general title of "Engineering Materials," the sub-titles of the other two being "Ferrous Materials" and

"Theory and Testing of Materials," respectively. As a basis for the present book, a good deal of the subject-matter of the earlier edition of the author's "Aircraft and Automobile Materials (Vol. II), Non-Ferrous and Organic" has been used. A large amount of new material has been added, however, to bring the subject-matter up to date. This is particularly noticeable in the case of aluminium and its alloys, to which two chapters are devoted, dealing also with the properties and uses of recently developed casting and heat-treatable commercial alloys produced under various trade names. Other light alloys which have come to the fore of recent years and which are fully considered are those of magnesium with aluminium, copper, or zinc, and beryllium with 20% of nickel or copper.

In the chapter on copper and its alloys reference is made to the nickel–brasses and –bronzes, which have received a good deal of attention of late, and to the development of the silicon–bronzes, but no mention is made of the copper–zinc–aluminium alloy manufactured under the name of "aluminium–bronze" and being increasingly used for condenser tubes. To condenser tubes and for other corrosion-resisting purposes special attention is given, however, by considering the various alloys of copper and nickel, including Monel metal. An interesting chapter also deals with the die-casting process and the various types of alloys for which this process is suitable.

In addition to dealing with non-ferrous metals and alloys, the book covers a wide range of other materials, including the structure, properties, and testing of timber; aircraft fabric and coverings; dopes and varnishes; glues and gluing; veneers and plywood; rubber and its compounds; and paints and painting. The chapters on timber and on engineering synthetic products are particularly interesting, as is also the last chapter, which deals with the X-ray method of examining material. This latest method of testing is dealt with in a very comprehensive manner and should be read with interest both by manufacturers and engineers.

The book is well illustrated and indexed and there are numerous footnote references which are of value, together with three appendices dealing with the physical properties of various metals, British Engineering Standard Specifications for aircraft materials and components, and Super-Duralumin (B.H.T.A. Metal). In the first appendix authorities might have been given with advantage for the various properties, as is done in the case of aluminium on page 5. Criticism might also be made of the large number of proprietary alloys and products referred to in the various chapters, and of the omission of certain well-known names among these. Apart from these few criticisms, the book fulfils the purpose for which it is written, and which the author stresses in the preface, when he states that it is intended, not as a metallurgical treatise, but as an elementary text-book on engineering materials, which will prove useful as a reference work to automobile and aircraft engineers, designers, draughtsmen, and students.

—J. W. Donaldson.

Lehrbuch der allgemeinen mechanischen Technologie der Metalle. Von Hermann Meyer. Sechste, neubearbeitete Auflage. Demy 8vo. Pp. viii + 332, with 402 illustrations. 1931. Leipzig: Max Janecke. (Kart R.M. 6; ganzleinen R. M. 7.20.)

(See *J.*, 1929, **41**, 712.) The majority of the sections in this, the sixth, edition of this book have been completely revised in keeping with modern developments in the mechanical treatment of metals. The original arrangement of the chapters has been retained, however, and a number of references to original work have been included. The general character of the work is of the same high standard as before and, owing to the additions, its usefulness to the student and the engineer is enhanced. It should be of particular interest that the ultimate employment of the materials considered is constantly borne in mind, and that the discussions are, on the whole, not too academic.—W. A. C. Newman.

Die Steigerung der Schwingungsfestigkeit von Gewinden durch Oberflachendrücken. Von Herbert Isemer. (Mitteilungen des Wöhler-Instituts, Braunschweig, Heft. 8.) Demy 8vo. Pp. iv + 64, with 21 illustrations. 1931. Berlin: NEM-Verlag, G.m.b.H. (R.M. 4.)

In this small book is described a series of experiments on the effect of surface treatment—mostly compression—on the strength of screw threads. Preliminary investigations involving comparisons between cylindrical and screwed test-pieces in various fatigue testing machines were undertaken. Full descriptions of the machines, the dimensions of the test-pieces, and the class of stress to which they were subjected are given throughout. The succeeding sections deal respectively with the main experiments—the preparation of the test-piece and the operation of the testing machine, the manipulation during the actual trial, and several tables of results that were obtained. A type of bending fatigue machine was used throughout. It was found that whereas compression at the base of the thread was effective to the extent of increasing the strength by more than 20%, any pressure on the sides of the threads had little effect.

—W. A. C. Newman.

Die Dämpfungsfähigkeit von Eisen und Nichteisenmetallen bei Dreh- und Biegeschwingungs-Beanspruchung. Von J. Schmidt. (Veröffentlichungen des Wöhler Instituts, Braunschweig, Heft 9.) Demy 8vo. Pp. 52, with 39 illustrations. 1931. Berlin: NEM-Verlag, G.m.b.H. (R.M. 4.)

Many investigations have been made into the damping effect in plastically deformed materials. These investigations showed the dependence of the damping on a particular state of stress—in torsional alternating stress on the shear stresses, and in bending fatigue on normal stresses. The object of this study is to complete the elucidation of these relationships in the case of ferrous and non-ferrous metals and alloys in the cast, pressed, and rolled conditions. The methods and technique adopted are fully described. It is shown that the ratio between the shear and normal stresses, with equal damping, amounts to 0·5–0·0 for ferrous and non-ferrous metals. The damping is essentially dependent on the shear stress. The limiting damping in torsion is in most materials greater than that in bending.—W. A. C. NEWMAN.

Chromium Plating. A Text-Book for the Practical Engineer, Electroplater, the Production Engineer, and the Student. By Edward S. Richards. Foreword by J. B. Maclean. Cr. 8vo. Pp. v + 131, with frontispiece and 70 illustrations in the text. 1932. London: Charles Griffin & Co., Ltd. (7*s.* 6*d.*)

This is a little book designed, in the language of the preface, for those who are already acquainted with the process of chromium plating, this experience being necessary to a reasonable appreciation of the matter which is treated.

Chromium plating marks one of the most recent advances in electro-deposition. It presents unusual features and is beset with unusual difficulties. These, however, while little understood at the inception of the practice of chrome plating, are by no means insuperable, and the author's function therefore is to give some easily understandable outline of the problem and practice of the art.

It can at once be stated that this task has been very successfully carried out. There may at first be some thought on the part of the uninitiated that the section on chromium plating does not appear until some 80 pages of preliminary matters have been dealt with. These preliminaries include the mechanical and chemical treatment of the surfaces to be chrome plated together with some knowledge of the deposition of copper and nickel, processes so vitally important and essential to successful plating that they merit all the space accorded to them.

In the chromium section there is some preference for the more dilute chromic acid solution which has proved so successful in this country. At the same time a comparison is made with prevailing French practice based on the author's personal experience, which leads to his conclusion that British practice is to be preferred.

The book is well illustrated and a number of diagrams exemplify the manner in which the several types of work which come in for chrome plating may best be wired. Other of the drawn diagrams, however, are possibly open to a little criticism, especially that on page 2, which is intended to give some idea of the manner in which metal generally finds its way from an anode to a cathode. Figs. 2 and 40 as layouts might have been more simply annotated, whilst the method of stirring indicated in Fig. 8 is, to say the least, a little vague.

The testing of deposits is undoubtedly a matter of importance deserving rather more attention than is accorded to it in the early part of the book, where a number of salt-spray tests are given for deposits which for this particular purpose are sadly undefined. More specific information might also have been forthcoming, after emphasizing the need for *pH* control, as to the manner in which lack of acidity in the nickel bath is to be corrected than "the addition of half a pint or so of sulphuric acid according to the size of the vat."

These are, however, little matters which can be corrected in a later edition which we confidently anticipate will sooner or later be required.—S. FIELD.