METALLURGICAL ABSTRACTS

(GENERAL AND NON-FERROUS)

I.—PROPERTIES OF METALS

A Unique Electrode Potential Characteristic of a Metal, and a Theory for the Mechanism of Electrode Potential [Cadmium]. A. L. McAulay and E. C. R. Spooner (*Proc. Roy. Soc.*, 1932, [A], **138**, 494–501).—For concentrations less than a definite limit, experimental results indicate that the potential of a cadmium electrode in an aqueous solution is independent of all changes in the character and constitution of the solution. It is concluded that the electrode potential must originate in interaction between the metal and water only. A theory of this result and three consequences of the theory are briefly discussed. The theory contemplates the formation of a layer of ions of thickness about 5×10^{-5} cm. surrounding the metal, the total concentration therein being about 4×10^{-5} grm.-mol. per litre. The electrode potential of cadmium in air-free dilute solutions of any sort is 0.787 v. against the saturated calomel electrode at $18°$ C. When an electrode is exposed to air, the potential becomes positive and unreproducible. The layer of positive ions surrounding the electrode is more concentrated in this case, and to this, and not to the formation of an impervious film, the change of potential is attributable.—J. S. G. T.

The Relaxation Time of Annealed Copper and Aluminium Wires Subjected to Torsional Oscillations. Dankwart Schenk (*Z. Physik*, 1932, **78**, 470–478).— [*Note by Abstractor :* The relaxation time of a material, *e.g.* of a wire, is related to the damping of vibration in the material. If torsional oscillations of respective frequencies N_1 and N_2 are characterized by logarithmic decrements D_1 and D_2 for equal strains, then the relaxation time, $1/R$, is given by $1/R = \pi(D_1 - D_2)/2(N_1 D_1 - N_2 D_2)$. The relaxation time of brass is about $1/1500$ second; its value for Duralumin is about $1/750$ second, for Elektron, about $1/100$ second.] The relaxation times of copper and aluminium wires subjected, after annealing, to torsional oscillations are found to depend on the amplitude of the oscillations and on the annealing temperature. Values of $1/R$ for copper range from $1/220$ to $1/140$ second. Results with aluminium wires were not so reproducible as in the case of copper wires. This result is probably associated with irregularity of the recrystallization process in aluminium, and with the presence of impurities. The results are interpreted in terms of structural changes occurring in the wires. Torsional oscillations are accompanied by motion within single crystals and motion of the crystals themselves. R depends on the relative importance of these two modes of motion.—J. S. G. T.

Null-Point for Charges on Copper and Silver. M. A. Proskurnin (*Zhurnal Fizicheskoy Khimii (Journal of Physical Chemistry)*, 1932, [W], **3**, (1), 91–96).— [In Russian.] Two methods are described, based on the observation of the e.m.f. generated by the change in ionic concentration in solution due to adsorption on the clean surface of the metal. Copper is found to have a null-point at -0.32 v., and silver at $+0.23$ v. against the N-calomel electrode. These values differ markedly from that found for mercury (-0.50 v.) by the electrocapillary method. The method of treatment of the surface has an important influence on the null-point.—N. A.

The Passivity of Gold. William James Shutt and Arthur Walton (*Trans. Faraday Soc.*, 1932, **28**, 740–752).—The time required for the potential of a passivated gold anode to fall to normal during spontaneous reactivation in acid chloride solutions has been determined under conditions which preclude the possibility of direct electrical polarization. The high temperature coeff. of the

rate of recovery suggests that the process of recovery is not controlled by simple solution of the film and diffusion of the products, but by a chemical reaction. Assuming that the film is a peroxide, to which assumption all the evidence points, this reaction would appear to be the formation of chlorine and auric oxide from hydrochloric acid and the peroxide and the subsequent dissolution of the auric oxide in the acid.—A. R. P.

Thermal Expansion of Lead. Peter Hidnert and W. T. Sweeney (*U.S. Bur. Stand. J. Research*, 1932, **9**, 703–709; *Research Paper* No. 500).— Measurements have been made on the linear thermal expansion of 3 samples of cast lead between room temperature and 300° C. and the results have been correlated with data obtained by other investigators between the years 1740 and 1931. A curve has been derived which shows the linear thermal expansion of lead between $-253°$ C. and $+300°$ C. Average coeff. of expansion for various temperature ranges between $-250°$ C. and $+300°$ C. as derived from the expansion curve are as follow ($\times 10^{-6}$) : $-250°$ to $+20°$ C., $25·1$; $-200°$ to $+20°$ C., $26·5$; $-100°$ to $20°$ C., $28·3$; $+20°$ to $60°$ C., $28·8$; $20°$ to $100°$ C., $29·1$; $20°$ to $200°$ C., $30·0$; $20°$ to $300°$ C., $31·3$. A comparison of the indirect results obtained by Kopp and Matthiessen with the direct data obtained by other observers indicates that lead expands the same in all directions.—S. G.

The Chamber Process. XXIII.—Physical and Mechanical Tests of Sheet Lead. Mototarō Matsui and Hirondo Katō (*Kōgyō Kwagaku Zasshi* (*J. Soc. Chem. Ind., Japan*), 1932, **35**, (7), 304B–306B).—[In Japanese, with English summary in supplemental binding.] The lead sheets tested were the following (trade names) : (1) Tadanac (Canada), technically pure, $99·99\%$; (2) B.M. (Burma), technically pure ; (3) Selby (U.S.A.) technically pure, $99·98 + \%$; (4) Selby (U.S.A.), lead 95, antimony 5% ; (5) unknown origin, lead $99·299$, zinc $0·188\%$, trace of arsenic, bismuth, aluminium, iron, etc. ; (6) Tadanac (Canada), bismuth 4–5, copper 1% ; (7) Tadanac (Canada), lead $99·987\%$. The samples had $d =$ (1) $11·36$, (2, 3, 6) $11·38$, (4) $11·21$, (5) $11·35$, and (7) $11·37$ and a Brinell hardness of (1) $2·88$, (2) $2·71$, (3) $3·03$, (4) $4·76$, (5, 6) $3·20$. The tensile strengths in kg./cm.^{2} were 152, 152, 155, 249, 160, and 183 and the elongations 40, 58, 66, $75·5$, $57·5$, and $52·5\%$ for samples nos. 1–6, respectively. The melting points of samples 1–7 were $328·1$, $327·5$, $327·6$, $308·9$, $327·6$, $324·7$, and $328·1°$ C. and the flash points in sulphuric acid 273, 287, 252, 270, 292, 300, and 270° C.—A. R. P.

Study of the Absorption of Gases by Metallic Magnesium and Calcium. V. P. Saraev (*Zhurnal Tehnicheskoy Fiziki* (*Journal of Technical Physics*), 1932, [B], **2**, (5), 442–449).—[In Russian.] The absorption of the residual gas in electric bulbs by powdered metals has for long been a common industrial practice, but a detailed study of the mechanism of gas absorption has not yet been made. In the present work the absorption of gases by magnesium and calcium, of various degrees of fineness, has been investigated. Absorption is intensified by ionization, in the absence of which nitrogen and hydrogen are not absorbed by magnesium. In the case of calcium the rate of disappearance of the neutral molecules of nitrogen increases with increase in the rate of pulverization of the metal. With rise in temperature magnesium gives up the absorbed gas, but with calcium the rate of absorption is greatly increased.

—N. A.

The Electrical Resistance and the Critical Point of Mercury. Francis Birch (*Phys. Rev.*, 1932, [ii], **41**, 640–648).—The relative resistance of liquid mercury compared with its value at 0° C. and 1 atm. pressure has been measured between 0° C. and 1200° C., and 1 and 4000 atm. ; values are also given for the instantaneous pressure and temperature coeff. of resistance, and a few measurements were made at higher pressures. All these quantities increase with rising temperature, and decrease with rising pressure. By assuming that below the liquid–vapour critical point the passage through the boiling

point will be accompanied by a discontinuous change in resistance whilst above the critical point the curve will be continuous, it is estimated that the critical point is at $1460 \pm 20°$ C. and 1640 ± 50 kg./cm.[2]. A bibliography of the literature concerning the critical constants of mercury is given.—W. H.-R.

The Effect of Strain on Magnetostriction and Magnetization in Nickel. C. W. Heaps (*Phys. Rev.*, 1932, [ii], **42**, 108–118).—Magnetic and magnetostrictive hysteresis loops have been obtained for pure annealed nickel wire by a heterodyne beat method. The magnetostrictive contraction $\frac{dL}{L}$ for both tensions $6·82$ and $3·70$ kg./mm.[2] is given accurately by the same equation $dL/L = -1·93 \times 10^{-10}I^2$ where I is the intensity of magnetization. For a tension of $0·72$ kg./mm.[2], the equation $dL/L = 1·30 \times 10^{-10}I^2$ holds less accurately. The curves for different tensions cross at large values of the magnetic field H, so that tension decreases the magnetostriction in small fields, but increases it in large fields. The fact that the same equation holds for both the larger tensions is explained by theories (Becker and Kersten, *Z. Physik*, 1930, **64**, 665) which suppose that tension tends to orientate the atomic magnets across the axis of tension; tensions of $3·70$ and $6·82$ kg./mm.[2] produce complete transverse orientation, whilst one of $0·72$ kg./mm.[2] leaves the atomic magnets essentially at random orientation. Experiments with commercial nickel wire bent into a circular arc are also described. This gives one half of the wire in tension and the other in compression, and at certain field strengths the magnetization becomes very unstable. It is shown that this explains both the large discontinuities in the magnetization curves of Forrer (*J. Physique*, 1926, **7**, 109; 1929, **10**, 247) and the smaller Barkhausen effects.—W. H.-R.

The Relative Permeability of Iron, Nickel, and Permalloy in High-Frequency Electromagnetic Fields. Edwin Michael Guyer (*J. Franklin Inst.*, 1932, **213**, 75–88).—Based on the experimental measurements described in the paper, it is concluded that there is no anomalous variation in the relative permeability of iron, nickel, and Permalloy at frequencies corresponding with the band of wave-lengths from 70 to 200 m. The results are contrary to those of certain other workers.—S. V. W.

The Exact Measurement of the Specific Heats of Solid Substances at High Temperatures. VI.—Metals in Stabilized and Non-Stabilized Condition : Platinum and Silver. F. M. Jaeger, E. Rosenbohm, and J. A. Bottema (*Proc. K. Akad. Wet. Amsterdam*, 1932, **35**, 763–771).—[In English.] Irreproducible results are obtained for the sp. heat of platinum unless the metal is first heated to $1600°$ C. and slowly cooled. This treatment has the effect of bringing the metal into a stable condition, but bears no relation to any allotropic change. The true sp. heat of stable platinum between $0°$ and $1400°$ C. can be calculated from the relation $c_p = 0·031678 + 0·630574 \times 10^{-5}t - 0·1624878 \times 10^{-9}t^2$, and that of hammered platinum ($0°$–$1100°$ C.) from $c_p = 0·031509 + 0·719102 \times 10^{-5}t - 0·94672 \times 10^{-9}t^2$. The true sp. heat ($0°$–$800°$ C.) of cast silver is given by $c_p = 0·055614 + 0·1600766 \times 10^{-4}t - 0·47223 \times 10^{-8}t^2$, and that of cold-plated silver by $c_p = 0·055936 + 0·105607 \times 10^{-4}t + 0·18165 \times 10^{-8}t^2$. Comparison with values recorded in the literature shows that the divergent results are due to working with non-stabilized metals.—E. S. H.

The Exact Measurement of the Specific Heats of Solid Substances at High Temperatures. VII.—Metals in Stabilized and Non-Stabilized Condition : Copper and Gold. F. M. Jaeger, E. Rosenbohm, and J. A. Bottema (*Proc. K. Akad. Wet. Amsterdam*, 1932, **35**, 772–779).—[In English.] Cf. preceding abstract. Stabilized, cast copper has a true sp. heat given by $c_p = 0·092597 + 0·20832 \times 10^{-4}t$, whilst the unstabilized, cold-rolled metal has $c_p = 0·093835 + 0·20684 \times 10^{-4}t$. After heating in a vacuum at $1050°$ C.

for 5 hrs. and cooling slowly, the rolled copper gives a value corresponding with that of stabilized copper. Gold which has been melted and then cooled gives $c_p = 0.03123 + 0.16635 \times 10^{-5}t + 0.46558 \times 10^{-8}t^2$, whilst cold-plated gold gives $c_p = 0.031341 + 0.93886 \times 10^{-6}t + 0.5127 \times 10^{-8}t^2$. It is inferred that no general prediction can be made as to the direction in which the sp. heats of worked and annealed metals will be changed.—E. S. H.

On the Behaviour of Polonium During the Crystallization of Metals. G. Tammann and A. v. Löwis of Menar (*Z. anorg. Chem.*, 1932, **205**, 145–162).— Even minute quantities of radioactive elements may be detected in metals by the aid of the photographic plate. Polonium during the crystallization of a metal collects in the polyeutectic, and with it is displaced towards the grain boundaries in which it finally collects. No polonium is ever found along the boundaries of recrystallization grains. From the width of the blackened areas on the plate it is deduced that the polonium occurs in monomolecular layers. The solid solubility of polonium in silver, tin, bismuth, zinc, cadmium, copper, antimony, and tellurium is of the order of $2.31 - 5.28 \times 10^{-11}\%$. In contrast to tellurium, polonium forms no intermetallic compounds; it is also practically insoluble in tellurides. In the crystallization of metals containing polonium, separation of this element begins at temperatures considerably higher than the melting point of the polyeutectic.—B. Bl.

On the Degassing of Tantalum. N. S. Ivanov (*Zhurnal eksperimentalnoy i teoreticheskoy Fiziki (Journal of Experimental and Theoretical Physics)*, 1932, [A], **2**, (3), 162–170).—[In Russian.] Hydrogen on the surface of red-hot tantalum undergoes dissociation. As the result of this, the hydrogen which is given off is adsorbed up to a limit of 2.4–3.6×10^{15} atoms/cm.^{2} on the surfaces of cold, clean glass vessels. If these are heated to 250° C. they no longer adsorb hydrogen.—N. A.

On the Change of the Specific Heat of Tin when Becoming Supra-Conductive. W. H. Keesom and J. A. Kok (*Proc. K. Akad. Wet. Amsterdam*, 1932, **35**, 743–748).—[In English.] Between 3.70 and 3.72° K. the atomic heat of tin decreases from 0.0078 to 0.0054. The exact temperature at which the change occurs agrees to within 0.01° C. with the transition to the superconducting state. That the specific heat change is connected with the phenomenon of superconductivity is shown by the fact that a magnetic field which impedes the occurrence of superconductivity also prevents the change in specific heat. There is no heat of transformation connected with the change to the super-conducting state.—E. S. H.

Behaviour of Vanadium and Vanadium–Iron Alloys towards Hydrogen. L. Kirschfeld and A. Sieverts (*Z. Elektrochem.*, 1930, **36**, 123–129; *C. Abs.*, 1930, **24**, 2093).—Absorption of hydrogen by vanadium (99%) at 1 atm. decreases with temperature from about 150 c.c. per grm. at 18° C. sharply to 38.3 c.c. at 400° C. and then more slowly to 2.7 c.c. at 1000° C. Impurities lower the values. This indicates 946 volumes of hydrogen per atom of vanadium, values similar to palladium–hydrogen. The saturated metal is yellow and darkens in the air. The hydrogen pressure curves by absorption and evolution are given for various temperatures and follow $m = k\sqrt{P}$ at 400° C., 600° C., and 800° C. A 9.1% ferro-vanadium goes through a minimum at 700° C. and above that the curve is similar to that of iron–hydrogen. A 22% ferro-vanadium remains much higher, has a minimum at 900° C. and above that parallels iron–hydrogen. A 70% ferro-vanadium does not saturate readily but parallels the vanadium curve. The curves show a two-component character and the higher the temperature the more closely the curve approaches a sum of the properties of the iron and vanadium present.—S. G.

The Photo-Electric Properties of Alkali Metal Films as a Function of their Thickness. James J. Brady (*Phys. Rev.*, 1932, [ii], **41**, 613–626).—Thin films of alkali metals were deposited upon a silver surface in a high vacuum by

means of a molecular beam under conditions in which the thickness of the film could be estimated. The effect of the thickness of the film upon the photo-electric properties was then examined. With cæsium, rubidium, and potassium the general effect is that a maximum threshold wave-length occurs at a thickness of a few (1·5 to 3) molecular layers, and a maximum total photo-electric emission in thicker (5 to 12) molecular layers, whilst final stable conditions are reached at a thickness of the order 12–20 molecular layers, the exact values varying with the metal. Sodium behaved quite anomalously. The results are discussed in terms of the Sommerfeld theory, the adsorbed alkali metal affecting the potential wall at the surface. It is concluded that the first few alkali atoms are adsorbed as ions and the later ones as neutral atoms.—W. H.-R.

Plasticity and Creep in Metals. Harold Jeffreys (*Proc. Roy. Soc.*, 1932, [A], **138**, 283–297).—The equations of plastic flow are derived mathematically; a theory of creep and its relation to experimental results are discussed.—J. T.

Mechanism of Plasticity (Preliminary Communication). N. Seljakov (*Zhurnal eksperimentalnoy i teoreticheskoy Fiziki (Journal of Experimental and Theoretical Physics*), 1932, [A], **2**, (2), 140).—[In Russian.] Cf. this *J.*, 1932, **50**, 597. In plastic deformation, the regions adjoining the planes along which slip has occurred show a change in the symmetry of the crystal lattice which, in the case of cubic lattices, is associated with a lowering of the symmetry of the lattice, due to elastic slip along the planes in the direction of the deformation.—N. A.

Cold Deformation, Crystal Recovery, and Recrystallization [of Metals]. H. Reischauer and F. Sauerwald (*Metallwirtschaft*, 1932, **11**, 579–581, 591–593, 604–607).—A review, with lengthy bibliography, of the deformation of metal crystals, the effect of temperature and purity on the deformation process, the change in physical properties on deforming single and poly-crystals, internal stress, crystal recovery, the formation of nuclei, and grain growth in recrystallization, and the structure of deformed and recrystallized metals.—v. G.

On the Dependence of the Endurance Strength on the Crystal Orientation. W. Fahrenhorst, K. Matthaes, and E. Schmidt (*Z.V.d.I.*, 1932, **76**, 797).— Fatigue tests in the alternating bending machine of the DVL have been made on specimens cut in different directions from a sheet of electrolytic copper recrystallized by annealing, so that the crystallites are oriented parallel to one another with a cube plane parallel to the surface of the sheet and a cube direction parallel to the direction of rolling. The endurance limit (10^6 alternations) follows closely the tensile strength, *i.e.* it is the same in directions at 0° and 90° to the cube direction, reaches a maximum at 45° and a minimum at 15° and 75° thereto. Edge deformation is a minimum at 45°. The elastic anisotropy of this type of sheet corresponds completely with the anisotropy of single copper crystals. Rolled but unannealed sheets show at least a qualitative agreement with the behaviour of single crystals.—v. G.

On the Indefiniteness of the Tensile Limits. Adolf Smekal (*Metallwirtschaft*, 1932, **11**, 551–554, 565–567).—The yield-point of sodium chloride crystals is a sharply defined constant of the crystal, whilst the tensile strength has a distribution function the course of which depends on the state of the material. In applying these results to metal crystals, the effect of heat movement must be taken into consideration.—v. G.

On the Change of Hardness of a Plate, Caused by Bending. Sadajirō Kokubo (*Kinzoku no Kenkyu*, 1932, **9**, (10), 447–456).—[In Japanese.] The change of hardness of a plate caused by bending, was measured by means of the Vickers hardness tester. The materials used were Armco iron, 0·2 and 0·7% carbon-steels, copper, brass, aluminium, Duralumin, and magnesium. The hardness-bending curves show that, in cold-rolled specimens, the hardness on the convex side of the plate decreases decidedly at first and then somewhat

slowly with increasing bending of the specimen, while on the concave side it increases only slightly. In annealed specimens the hardness on the convex side decreases at first, and then, after passing through a minimum, it increases slightly with increased bending of the specimen; on the concave side the hardness increases gradually with an increased degree of bending. These changes of hardness are satisfactorily explained as the combined effect of the applied stress and the work-hardening caused by the bending of the specimens.
—S. G.

On the Effect of Torsion on the Density, the Dimensions, and the Electrical Resistance of Metals. Tarô Uéda (*Kinzoku no Kenkyu*), 1932, **9**, (10), 417–446).—[In Japanese.] The change of the density, dimensions, and electrical resistance in Armco iron, Swedish steels, brass, nickel, and copper when twisted in a torsion machine were measured. The densities of iron and steel decrease with twisting and their rate of decrease is considerable up to the yield-point. The length of the specimens increases slightly with the angle of twist, but beyond the yield-point the elongation becomes greater and greater. The electrical resistance increases as the angle of twist increases, and up to the yield-point its rate of increase is very large, this change being quite similar to that of the shear stress. In the case of copper and brass, these changes are in general similar to those for iron and steel, but for brass the rate of change is very large and for copper very small. They increase continuously from the beginning of torsion, and no such abrupt change is observed as in iron and steel. For nickel the change is very large at the beginning of torsion, but from this point it increases only slowly.—S. G.

Micrometal Trees. Walther Haas (*Wiss. Mitt. Österr. Heilmittelstelle*, **1930**, (10), 10–12; *Chem. Zentr.*, 1931, **102**, II, 1109; *C. Abs.*, 1932, **26**, 4259).—The phenomena to be observed when salt solutions are electrolyzed between platinum wires are described. Photographs of trees of lead, thallium, silver and copper are shown.—S. G.

The Diffusion of Metals in the Solid State. G. Grube and A. Jedele (*Z. Elektrochem.*, 1932, **38**, 799–807).—Cast cylinders of pure nickel and of nickel containing manganese 0·5% were drawn to 5·5 mm. diam. and copper-plated. After various periods of time at 1000°–1025° C. in a hydrogen atmosphere, thin layers were removed and analyzed electrolytically for copper and nickel. The diffusion coeff., D, is given by $\dfrac{C_0 - c}{c} = \phi\left(\dfrac{z}{2\sqrt{Dt}}\right)$, where $C_0 =$ initial concentration (50%), $c =$ result of analysis, $t =$ time in days, $z =$ depth of penetration, in cm., and $\phi =$ Gauss's error integral. The diffusion of nickel into copper in the solid state is more rapid than that of copper into nickel. In copper–nickel solid solutions, the diffusion rate is constant with increasing copper content. In the nickel-rich alloys, $D =$ about 1×10^{-5} cm.^{2}/day, and in the copper-rich alloys about 4×10^{-5} cm.^{2}/day. With manganiferous nickel, the diffusion rate of copper is lower, being about $0·3 \times 10^{-5}$ cm.^{2}/day at the above temperatures. The diffusion rate is greater the nearer the temperature is to the solidification temperature of the alloy. The greatest resistance to corrosion in ammonium carbonate solutions containing hydrogen peroxide occurs with the alloy containing 30 atomic-% nickel. Both components are attacked by sulphuric acid solutions containing potassium chlorate. Corrosion cracks increase with increasing nickel content up to 75–80 atomic-% nickel, owing to the fact that the magnetic α-phase is less attacked than the non-magnetic β.—J. H. W.

Diffusion. W. Rosenhain (*Metallurgist* (Suppt. to *Engineer*), 1932, **8**, 125–126).—Theories of diffusion are briefly reviewed. The simple kinetic theory does not appear tenable in view of knowledge of the behaviour of atoms on close-packed lattices, and the " slip theory " is accordingly again put forward as a working hypothesis which explains the outstanding facts.—R. G.

On the Heats of Formation of Nitrides. III.—The Heats of Solution of Some Metals and Metal Nitrides in Acids. B. Neumann, C. Kröger, and H. Kunz (*Z. anorg. Chem.*, 1932, **207**, 133–144).—The heats of solution of chromium, magnesium, cerium, lanthanum, magnesium nitride Mg_3N_2, cerium nitride CeN, and lanthanum nitride LaN in 1 : 20 hydrochloric acid and of manganese nitride Mn_5N_2 in 1 : 12·7 sulphuric acid were determined.—M. H.

A Method of Measuring Very Small Vapour Pressures with the Torsion Balance. Kurt Neumann and Ernst Völker (*Z. physikal. Chem.*, 1932, [*A*], **161**, 33–45).—The vapour pressure of mercury between 16° and 70° C. and of potassium between 145° and 200° C. has been determined.—B. Bl.

Tribo-Electricity and Friction. VII.—Quantitative Results for Metals and Other Solid Elements with Silica. P. E. Shaw and E. W. L. Leavey (*Proc. Roy. Soc.*, 1932, [*A*], **138**, 502–514).—The development of electrification by rubbing pure metals (purity greater than 99·7%) including gold, platinum, silver, copper, iron, nickel, aluminium, tin, cadmium, antimony, chromium, and metals of commercial purity, including lead, zinc, bismuth, cobalt, thallium, and selenium against silica, is investigated experimentally and a theory of the phenomenon is developed. Ten factors are involved, and of these, a group of two, associated with the generation of the Volta contact effect, is paramount for most elements but not for all.—J. S. G. T.

The Theory of Metals.—I. A. H. Wilson (*Proc. Roy. Soc.*, 1932, [*A*], **138**, 594–606).—Interaction between electronic motions and nuclear vibrations in a metal is discussed theoretically. The " mean free path " of the electrons is evaluated, and existing theories of conduction are critically examined. The refinements introduced by Peierls are considered unnecessary; their omission simplifies the theory.—J. S. G. T.

The [Electrical] Resistivity of Polycrystalline Wires in Relation to Plastic Deformation, and the Mechanism of Plastic Flow. E. N. da C. Andrade and B. Chalmers (*Proc. Roy. Soc.*, 1932, [*A*], **138**, 348–374).—The specific electrical resistance of certain typical metals, including cadmium, copper, aluminium, and tin, has been determined at various stages of plastic flow under large stresses, and it has been shown that the resistance of metals which crystallize in the cubic system is unaffected by the flow. The specific resistance of metals which crystallize with a unique axis of symmetry does not change during two of the three stages into which the flow can be analyzed, viz. during the initial immediate extension and the final flow at constant rate. During the intermediate stage of flow at diminishing rate, called the β-flow, the specific resistance changes by about 2% in extreme cases. The results are interpreted on the assumption that the crystallites slip, with consequent rotation of the unique axis, during the β-flow. On this hypothesis, an increase of specific resistance with extension is to be anticipated in the case of metals the crystals of which have slip planes parallel to the unique axis. In the case of crystallites having slip planes normal to the unique axis, there should occur a decrease of specific resistance on extension, in those cases where the resistance is greatest along the unique axis. The theory is supported by results obtained at low temperatures when marked immediate stretch occurs but no β-stretch. In these circumstances an increase of resistance is obtained with cadmium while a decrease occurs at ordinary temperatures. This increase is attributable to extensive twinning.—J. S. G. T.

On the Electrical Properties of the Group of So-Called " Semi-Conductors." A. Schulze (*Helios* (*Fachzeit.*), 1932, **38**, 201–204, 211–213).—The electrical behaviour of the semi-conductors, silicon, graphite, titanium, zirconium, hafnium, thorium, germanium, boron, arsenic, and tellurium are discussed with reference to the literature. It is pointed out that, so far as investigations have been made, single crystals of these substances have a metallic

conductivity, so that the negative temperature coeff. of polycrystalline material is to be attributed to a grain boundary effect.—v. G.

Barkhausen Effect. III.—Nature of Change of Magnetization in Elementary Domains. Richard M. Bozorth and Joy F. Dillinger (*Phys. Rev.*, 1932, [ii], **41**, 345–355).—The small sudden changes in magnetic moment which occur when a metal is magnetized have components both parallel and perpendicular to the direction of the magnetic field. The latter effect is detected for the first time with annealed and hard-worked iron, and annealed Perminvar containing iron 30, cobalt 25, nickel 45%, with 0·1% silicon as impurity. The relative importance of the two effects depends on the material, and on the degree of magnetization of the specimen as a whole. The new transverse effect is relatively small when the magnetizing field H is less than the coercive force, and may be equal to or greater than the longitudinal effect when the magnetization of the material approaches saturation. The data are interpreted in terms of the domain theory, and suggest that magnetic materials are divided into small domains, each of which is magnetized to saturation, the magnetization being controlled in some domains by strain, and in others by the crystal lattice, the relative effect of strain being increased by cold-work. Perminvar shows peculiarities, and may be a mixture of two magnetic materials.—W. H.-R.

On Ferromagnetism and Related Problems of the Theory of Electrons. Paul S. Epstein (*Phys. Rev.*, 1932, [ii], **41**, 91–109).—Theoretical. Starting with the theory of Slater (this *J.*, 1930, **44**, 468) concerning cohesion in metals, the electronic theory of homopolar bonds in metallic crystals is developed for both magnetic and non-magnetic elements. As suggested by Heisenberg, the Pauli exclusion principle influences the orientation of the spins of the valency electrons, and the deciding factor is the sign of the Heitler–London interchange integral J_1. Materials with large negative values of J_1 are non-magnetic, those with small values (either $+$ or $-$) of J_1 are paramagnetic, and those with large positive values may be ferromagnetic. The theory of Bloch (*Z. Physik*, 1928, **52**, 555; 1930, **59**, 208; **61**, 206; 1932, **74**, 295) is confirmed for non-magnetic metals, but E.'s results for magnetic metals are different and new. The new theory demands the existence of a block structure in ferromagnetic metals, the blocks being in a state of permanent spontaneous magnetization, the polarity of which changes frequently, its direction being related to the crystallographic axes, although this relation is ignored in the calculations. At low temperatures the sp. heat of a magnetic metal is given by $c = 0·208sR(T/\theta)^{3/2}$, where R is the gas constant, s the number of valency electrons per atom, and θ is closely related to the Curie point.—W. H.-R.

The Ferromagnetic Moments of the Elements and the Periodic System. Charles Sadron (*Ann. Physique*, 1932, [x], **17**, 371–452).—The magnetic properties of binary alloys of nickel and of cobalt have been examined as a function of the percentage composition; only those alloys in which simple solid solutions are formed have been studied. The behaviour of manganese–nickel and manganese–cobalt alloys suggests that the atoms of manganese are oriented in a direction parallel to that of the surrounding ferromagnetic atoms, and on the basis of this hypothesis a moment of 15·0 magnetons is attributed to the manganese atom. By extension of the hypothesis the atomic moments of 15 other metals have been determined. For the elements in any one column of the periodic table the atomic moment is constant. For the metals from copper to vanadium in the first long period, the atomic moment increases with increasing atomic number according to a linear law, the increment being 5·25 magnetons, whilst for those from vanadium to nickel the rate of change is linear but negative, and amounts to $-4·0$ magnetons.—H. F. G.

Experiments on the Nature of Ferromagnetism. Francis Bitter (*Phys. Rev.*, 1932, [ii], **41**, 507–515).—The presence of irregularities in ferromagnetic crystals has been detected by allowing a fine suspension of ferric oxide particles

in ethyl acetate to settle on the surface of carefully prepared crystals. Experiments were made both with and without an applied field on crystals of iron, cobalt, nickel, and of alloys of iron with silicon or nickel. On crystals of cobalt straight lines are obtained on some crystals, whilst others give spotty patterns in which the spots tend [to form a hexagonal array. The general tendency is to form line patterns in which the lines can appear in 3 directions in each crystal of iron, 4 in nickel, but only 1 in cobalt. It is suggested that the patterns are somehow related to the three (100) axes in iron, the four (111) axes in nickel, and the single (0001) axis in cobalt, and it is significant that in each case the axis mentioned is the direction of easiest magnetization. The patterns are readily destroyed by surface strains.—W. H.-R.

II.—PROPERTIES OF ALLOYS

Preparation of Single Crystals of Duralumin, Tin–Bronze and " Aluminium–Bronze " and the Study of their Properties. M. P. Slavinsky and A. P. Belaiev (*Metallurg* (*The Metallurgist*), 1931, **7**, (1), 3–19).—[In Russian.] Former work on the production and properties of single crystals of aluminium and its alloys is summarized. Owing to the inconclusive nature of existing data and the possibility of practical value resulting from changes in properties (*e.g.* electrical conductivity), single crystals of pure aluminium and Duralumin were prepared and investigated. The specimens were obtained both by very slow cooling of castings and also by repeated work-hardening and normalizing. With Duralumin the first method gave a structure showing large inclusions of $CuAl_2$, only a very small proportion of the copper remaining in the solid solution. The mechanical properties were poor and showed nothing of note. The second method did not give a single crystal and had no marked influence on the properties. Slow cooling of tin–bronze (with or without additions of zinc and phosphorus) and " aluminium–bronze " produced a dendritic structure, which, nevertheless, was monocrystalline in type, except when liquation phenomena could take place. Specimens of these alloys obtained by rapid cooling and consisting of several crystal grains were converted into a condition approximating to single crystals by annealing, with a resulting decrease in mechanical properties as is sometimes observed on annealing castings which have been made under certain conditions of cooling. Finally, the process of recrystallization by work-hardening and annealing gives these alloys a single crystal structure which is, however, not identical with that obtained by very slow cooling from the molten condition.—M. Z.

Strength Tests on Thin-Walled Duralumin Cylinders in Torsion. Eugene E. Lundquist (*U.S. Nat. Advis. Cttee. Aeronautics, Tech. Note* No. 427, 1932, 1–8, and appended plates and diagrams).—Torsion tests on Duralumin cylinders of specified dimensions are described. The influence of the ratios length/radius and radius/thickness on the type of failure is discussed, and an equation for calculating the shearing stress at failure is given, in the form :

$S_s = K_s E \big/ \left(\frac{r}{t}\right) n$, where n is a constant for any given material, K_s varies with

the length/radius ratio $\frac{l}{r}$, E is the modulus of elasticity, r the radius, and

t the thickness of the cylinder. In this case, the tentative value of 1·35 is assumed for n, and corresponding values of K_s and r are given. The formation, direction, and number of shearing wrinkles and the influence of slight imperfections are discussed.—P. M. C. R.

Hardening of Non-Ferrous Alloys. V. Christiansen (*Teknisk Tids.*, Uppl. C, *Bergsvetenskap.* **61**, 1931, 39–43, 47–53; *C. Abs.*, 1932, **26**, 5285).—The principles and courses of the hardening processes for non-ferrous alloys on

annealing are described. The theory of the "critical dispersion" of CuAl$_2$ crystals in Duralumin during its after-hardening at room temperature is discussed and criticized. Such a separation of crystals could not be detected microscopically or by X-ray methods, neither could changes in the solid solution parameter be observed nor indications of new interferences originating from new kinds of crystals. A series of new observations also offers difficulties in applying the simple explanation of the dispersion theory. In a solid solution of two metals, as, for example, of copper and aluminium in Duralumin, the electrical resistance should decrease if a separation in one form or another takes place, because the main constituent is thereby rendered purer. During the process of hardening Duralumin at room temperature the electrical resistance generally increases. It is difficult to explain the fact that when Duralumin and other alloys are first permitted to harden at room temperature for a certain time after quenching and later at higher temperatures, a decrease in hardness will first take place, after which the hardness increases faster and to a higher degree than before. The mechanical properties of alloys of the Duralumin type and the changes in these resulting from different hardening processes are described. The effects of the presence of magnesium, lithium, manganese, and silicon in such alloys are discussed. A series of alloys with copper as the main constituent, such as copper-beryllium alloys and Corson and Heusler alloys; their hardening processes; mechanical, electrical, and chemical properties, are described. A number of "noble" metal alloys capable of being hardened are also discussed.—S. G.

Contribution to the Study of Aluminium–Iron–Chromium Alloys.—II. Ch. Taillander (*Rev. Mét.*, 1932, **29**, 348–356).—Cf. this *J.*, 1932, **50**, 600. Metallographic investigations and mechanical tests are described. The latter include tensile tests, notched-bar tests, and hardness tests at normal and at elevated temperatures. The alloys contained up to 2·29% of chromium and 4·18% of iron. Thermal analysis and micrographic analysis indicate a ternary eutectic at 2% of chromium and 1% of iron. Dilatation tests indicate diminution by iron and chromium. 2 to 2·5% of iron and chromium may be introduced into aluminium without rendering it very brittle. The maximum tensile stress and notched-bar values are improved. In this range of composition the alloys retain the white colour of aluminium.—H. S.

Binary Aluminium–Manganese Alloys. M. Bosshard (*Light Metals Research*, 1932, **2**, (11), 9–10).—The tensile strength, elongation, and electrical conductivity of aluminium–manganese alloys containing 0·5–3·5% of manganese have been determined. Values are tabulated for sheet 1 mm. and 2 mm. thick. The sheet was reduced 80–90% by cold-rolling after an intermediate anneal at 420° C. The tensile strength was increased by the addition of manganese up to 1·4%, after which further additions had little effect. The conductivity was reduced by manganese, the effect being less pronounced after the addition of 1·4% manganese. The behaviour of the alloys during hot- and cold-rolling was similar to that of aluminium. The corrosion-resistance of those with more than 1% manganese was found to be superior to that of 99·5% aluminium when tested by both Mylius's tests.—J. C. C.

Aluminium–Silicon Alloys.—I. —— Broniewski and —— Smialowski (*Rev. Mét.*, 1932, **29**, 542–552).—The methods of investigation employed include thermal analysis, electrical resistivity, thermoelectric force, solution potential, dilatation, hardness tests, and micrography. The aluminium used was of 99·7% purity, and the silicon 97·3%, the latter containing 1·2% of iron and 1·5% of aluminium as impurities. B. and S. conclude from their results that the Al–Si eutectic occurs at 11·5 atomic % silicon and melts at 575° C. The silicon-rich solid solution contains 96% of silicon at the solidus temperature and 97% at room temperature. The alloys containing about 94% of silicon have a specific resistance of 0·07 ohms/cm.^{3} and a temperature coeff. of about

zero. A thermoelectric couple composed of alloys of 96 and 97% of silicon gives a thermoelectric force $E \, 10^6 = 656 \, t + 0.98 \, t^2$, the couple being one of the most powerful known up to the present. The hyper-eutectic alloys may be used as light antifriction alloys provided that the steel journals have a Brinell hardness above 500° C., *e.g.* are nitrogen-hardened. In a general way the indirect methods of investigation employed in establishing the structure of aluminium–silicon alloys gave normal results in spite of the rather peculiar properties of silicon.—H. S.

Characteristics of Cast Aluminium Alloys as Influenced by their Composition and Structure. C. Panseri (*Alluminio*, 1932, **1**, 279–307).—The technique of casting pistons for internal combustion engines is described, and the macro-structure and compositions are correlated with the casting properties. The problem of stresses derived from thermal treatment, and the effects of various treatments on certain alloys have been studied. The equilibrium diagrams of the silicon–magnesium–aluminium and nickel–copper–magnesium silicide-aluminium systems have been fully investigated. A description is given of a new alloy—Duralite—containing copper 3, silicon 0·7, nickel 0·5, magnesium 0·5, iron 1·5, titanium 0·2%. It is one of a series of alloys which attempts to combine the good technical properties of " Y " alloy with the good casting properties of alloys containing large quantities of copper. Certain other properties of various piston alloys are discussed, and it is concluded that the best alloys are those of the Duralite type.—G. G.

Special [Proprietory] Aluminium Alloys. Edmund Richard Thews (*Metallbörse*, 1932, **22**, 545–546, 577–578).—An alphabetical list of proprietory alloys with notes of their composition where published.—A. R. P.

On the Magnetostriction of Iron–Cobalt Alloys. Yosio Masiyama (*Sci. Rep. Tôhoku Imp. Univ.*, 1932, [i], **21**, 394–410).—[In English.] The whole series of alloys has been studied. The longitudinal and transverse effects are in opposite senses and the change of volume is a differential effect. A marked discontinuity was observed in the expansion–concentration curve in both the longitudinal and transverse effects at about 80% of cobalt. This corresponds with the phase change from α- to γ-solid solution.—E. S. H.

On the Grain-Refinement of Copper-Rich Alloys by Peritectic Reaction. Ju-n Asato (*Kinzoku no Kenkyu*, 1932, **9**, (9), 392–416).—[In Japanese.] It is well known that the crystal grains of " aluminium–bronze " become very fine when iron is added, but there has been no clear explanation for this. A. has found that this grain-refinement is closely related to the peritectic reaction between copper and iron, from experiments with copper–iron, copper–zinc–iron, copper–tin–iron, copper–manganese–iron, and copper–aluminium–iron alloys. A. has also found that in the above series of alloys iron may be replaced by cobalt as the latter is similar to iron in its behaviour towards copper.—S. G.

The Reaction Capacity of Alloys and its Dependence on Melting or on Transformations in the Solid State. I.—Chemical Reactions of Copper–Tin Alloys with Lime or Quartz in Oxygen. J. Arvid Hedvall and F. Hander (*Z. anorg. Chem.*, 1932, **203**, 373–389).—Intermetallic compounds react with alkaline-earth oxides in the presence of oxygen on heating, especially at transformation temperatures or at temperatures at which break-up of the lattice occurs. The reactions between CuSn and lime and between CuSn or Cu_3Sn and SiO_2 have been investigated. They are of importance in respect of their effect on the stability of melting crucibles.—B. Bl.

Analyses of Old Bronzes. J. Sebelien (*Avh. Norske Vid.-Akad. Oslo*, 1931, (3), 3–9; *C. Abs.*, 1932, **26**, 4575).—Cf. this *J.*, 1932, **50**, 349. A bronze nail from the gates of the palace of Shalmanesir II contained copper 81·1, tin 11·4, lead 0·47, iron 0·51, zinc 0·19, and arsenic 0·12%. Old Chinese bronzes generally contain a high proportion of lead with little or no zinc.

Knife coins of the Ming series contained copper 47, tin 1·5, zinc 1, lead 43·5, and arsenic 1%. Analyses of many old Norwegian bronzes gave tin 3–17%, and no evidence was found of a Copper Age preceding the Bronze Age. The compositions of 10 bronze coins of various countries minted between 90 B.C. and A.D. 1828 are tabulated.—S. G.

Properties and Uses of Lead–Rich Bearing Bronzes. Anon. (*Metallbörse*, 1932, **22**, 483).—The composition and mechanical properties of some leaded bearing bronzes for special purposes are tabulated. The information given is taken chiefly from the work of Clamer (*J. Franklin Inst.*, 1903, **156**, 49) and from publications of the A.S.T.M. (see *Met. Ind.* (*N.Y.*), 1931, **29**, 517).
—A. R. P.

The Equilibrium Diagram of Lead–Tin Bronzes. Jószef Veszelka (*Bányászati és Kohászati Lapok*, 1932, **65**, 212–220, 237–244; *Chem. Zentr.*, 1932, **103**, II, 1504).—The mechanism of crystallization of copper–tin alloys with constant lead content of 2 and 5% is described. Similar effects have been observed to those found by Bauer and Hansen in the copper–zinc–lead system. Sectional diagrams for the 2 and 5% lead alloys have been constructed based on micrographic examination. Giolitti and Marantonio's observations (*Gazz. chim. ital.*, 1910, **40**, 51) on the distribution of lead in the constituents of cast bronze are shown to be erroneous.—A. R. P.

The Technological Properties of Nickel–Bronzes. Anon. (*Metallbörse*, 1932, **22**, 1134–1135).—A review of recent work on the effect of additions of 1–3% of nickel on the mechanical properties of bronze with up to 12% tin or tin + zinc.—A. R. P.

The Separation of the α-Phase in β-Brass. M. Straumanis and J. Weerts (*Z. Physik*, 1932, **78**, 1–16).—The process of separation of the cubic face-centred α-phase from the copper-rich cubic space-centred β-phase of the copper–zinc alloys has been investigated by X-ray and microscopic examination of single-crystals of the alloys. The α-crystallites are found to be preferentially oriented in 24 different strata independently of the nature of the heat-treatment. The accompanying lattice transformation can be interpreted in terms of slip processes and is crystallographically reversible. The mechanism involved in the orientation and transformation appears to be the reverse of that suggested by Kurdjumow and Sachs for the austenite–martensite transformation. Under conditions of considerable super-cooling and marked supersaturation, the character and arrangement of the α-crystallites are controlled by the slip mechanism in accordance with the symmetry of the β-lattice, with the resulting production of considerable regions of laminar precipitation. Rod-like precipitation characterizes higher annealing temperatures.—J. T.

The α- and β-Solid Solutions of the Copper–Zinc Alloys and the Corresponding Liquid Solutions in Equilibrium with Them Examined Thermodynamically. F. H. Jeffery (*Trans. Faraday Soc.*, 1932, **28**, 452–455).—Thermodynamic analysis of the equilibria in the copper–zinc systems indicates that the liquid solutions in equilibrium with the α- and β-solid solutions consist of $CuZn_4$ dissolved in monatomic molecules of copper, that the α-solid solution consists of $CuZn_4$ dissolved in monatomic copper, and that the β-solid solution consists of $CuZn_2$ dissolved in monatomic copper. The complex nature of these liquid and solid solutions seems to be consistent with the formation of metastable states. As the corresponding copper–tin solid solutions consist of Cu_4Sn and tin in copper, respectively, the analogy found between the α- and β-phases in the copper–tin and copper–zinc systems by X-rays is not in accordance with the laws of thermodynamics, assuming J.'s premises to be correct.—A. R. P.

On Transformation Processes in β-Brass and β-Silver–Zinc Alloys. J. Weerts (*Z. Metallkunde*, 1932, **24**, 265–270; discussion, 270).—The separation of cubic face-centred α from cubic body-centred β in brass and the transformation of cubic body-centred β into hexagonal ζ in silver–zinc alloys have

been studied by röntgenographic and micrographic examination and by measurements of the electrical resistance and hardness during ageing of quenched specimens. Both transformations are governed by strict crystallographic lattice relations, the former being characterized by a gliding of the atoms similar to that of the martensite transformation, and the latter, by growth from a constant number of nuclei with a constant linear velocity of crystal growth.—M. H.

Alloys of Gallium. W. Kroll (*Metallwirtschaft*, 1932, **11**, 435–437).—Alloys of gallium with iron, nickel, copper, zinc, magnesium, bismuth, aluminium, lead, cadmium, and tin have been investigated. Those with the first three metals do not age-harden. Alloying copper with gallium produces only a very small hardening effect. More than 0.5% gallium in zinc spoils the mechanical properties, especially at high temperatures. Magnesium dissolves a maximum of about 4–6% gallium, but the alloys can be age-hardened only slightly. Low-melting-point binary and polynary alloys of gallium with cadmium, bismuth, lead, tin, and zinc contain eutectics; the alloy of gallium with 12% tin melts at 15° C. The eutectic arrest point can be detected in alloys with very high percentages of the second and third metals. Lead with 0.2% gallium is as brittle as 12% antimonial lead. Binary aluminium alloys with small percentages of gallium cannot be age-hardened, but can be readily rolled, addition of gallium increasing the hardness of aluminium only slightly. Ternary gallium–magnesium–aluminium alloys age-harden in a similar way to zinc–magnesium–aluminium alloys, a small effect being observed at room temperature and a maximum hardness of 112 being obtained on ageing above 100° C. Lithium–gallium–aluminium alloys behave similarly. The 4% gallium–aluminium alloy slowly disintegrates in moist air.—v. G.

Coloured Gold Alloys. E. Vincke (*Mitt. Forschungsinst. Edelmetalle*, 1932, **6**, 1–8).—Formulæ, melting points, and colour of so-called red, yellow, and white gold alloys of various carats are tabulated and the melting and working conditions are discussed.—A. R. P.

The Super-Conductivity of Gold–Bismuth [Alloys]. W. J. de Haas and T. Jurriaanse (*Proc. K. Akad. Wet. Amsterdam*, 1932, **35**, 748–750).—[In English.] Cf. this *J.*, 1932, **50**, 16. X-ray analysis has shown that gold–bismuth alloys containing 10, 20, or 40% of bismuth contain a phase of the composition Au_2Bi, which can be separated by washing out the bismuth with nitric acid. The compound Au_2Bi becomes superconducting in liquid helium at the same temperature as the gold–bismuth alloys, and is therefore held to account for the superconductivity of this series of alloys. The crystals of Au_2Bi are cubic, having an edge of 7·94 A. The density determined by X-ray analysis is 15·70, agreeing with the pyknometric value 15·46.—E. S. H.

On the Law of Additive Atomic Heats in Intermetallic Compounds. IX.— Compounds of Tin and Gold, and of Gold and Antimony. J. A. Bottema and F. M. Jaeger (*Proc. K. Akad. Wet. Amsterdam*, 1932, **35**, 916–928).—[In English.] The existence of pure, hexagonal AuSn has been confirmed by X-ray examination and chemical analysis. Its structure is analogous to that of PtSn. The sp. volume is about 12% smaller than the sum of the sp. volumes of its components. The true sp. heat of AuSn can be calculated at any temperature t from the relation $c_p = 0.039649 - 0.3358 \times 10^{-6} t + 2.9337 \times 10^{-8} t^2$. The molecular heat of the compound is shown to be less than the sum of the atomic heats of the components (as with PtSn). The sp. heat of Sn in AuSn is, however, different from that of Sn in PtSn. The compound $AuSb_2$ was produced by melting the constituents together in hydrogen and tempering and re-melting the mass until a homogeneous product was obtained. It possesses a pyrite structure. At 355° C. the γ form is transformed into a β form, which is converted into an α form at about 405° C. The true sp. heats of these modifications are given by $\gamma c_p = 0.043626 -$

$0.189064 \times 10^{-4} t + 0.79563 \times 10^{-7} t^2$, $\beta c_p = -0.169785 + 0.22014 \times 10^{-2} t$ $- 0.42252 \times 10^{-5} t^2$, $\alpha c_p = 0.45389 - 0.39127 \times 10^{-2} t + 0.70257 \times 10^{-5} t^2$. The sp. heat of antimony has also been determined. There is a transformation point $\alpha \rightleftharpoons \beta$ at about 413° C. The results are expressed by the formulæ $\beta c_p = 0.0535656 - 0.46635 \times 10^{-4} t + 0.15497 \times 10^{-6} t^2$, $\alpha c_p = 0.534496 - 0.4522 \times 10^{-2} t + 0.7944 \times 10^{-5} t^2$. The rule of additive atomic heats is again not valid, but the deviation is in the opposite direction; the molecular heat of $AuSb_2$ is greater than the sum of the atomic heats of the constituents.—E. S. H.

On the Law of Additive Atomic Heats in the Case of Intermetallic Mixed Crystals. X.—Silver and Gold. J. A. Bottema and F. M. Jaeger (*Proc. K. Akad. Wet. Amsterdam*, 1932, **35**, 929–931).—[In English.] An alloy containing gold 25·56 and silver 74·44 atoms % has a true specific heat given by $c_p = 0.04561 + 0.1118 \times 10^{-4} t$. Comparison with the values for pure gold and silver shows that there are small deviations from the rule of additive atomic heats even in mixed crystals and that the deviations increase with rising temperature. The deviations are not considerable, except above 600° C.
—E. S. H.

The Lead-Rich Alloys of the System Lead–Antimony Examined Thermodynamically. F. H. Jeffery (*Trans. Faraday Soc.*, 1932, **28**, 567–569).—The equilibria at the lead end of the lead–antimony system can be explained thermodynamically only on the assumption that the compound Pb_2Sb exists in the liquid and solid solutions dissolved in monatomic molecules of lead. The formation of this compound in solid solution accounts for the hardening effect of small quantities of antimony on lead. It is pointed out that X-ray analysis fails to detect the presence of a compound in the lead–antimony alloys.—A. R. P.

Manganese–Nickel Alloys.—I.–II. A. Dourdine (*Rev. Mét.*, 1932, **29**, 507–518, 565–573).—(I) Thermal analysis indicated solid solution on the nickel side up to 38% of manganese, and on the manganese side up to about 59%. At intermediate concentrations (38–59% manganese) a new constituent is formed in the last stages of crystallization. At concentrations between 32 and 68% of manganese, a series of thermal effects in the solid state is observed, and special attention has been paid to these by D. (II) The manganese-nickel alloys crystallize partly in a stable condition and partly in an unstable condition on cooling at the usual rates. The unstable condition occurs between 43·2% and 58·5% manganese. In the unstable condition the alloys form an unbroken series of solid solutions except, perhaps, at concentrations in the vicinity of pure manganese. The change to the stable condition occurs completely when the alloys are maintained for a more or less prolonged time in the vicinity of the solidus. In the stable condition, the range of solid solutions is broken by two heterogeneous regions between 43·2 and 48·37% and 49 and 58·5% of manganese respectively. In these heterogeneous regions three phases are distinguished : β solid solution of manganese in nickel; γ solid solution of nickel in γ-manganese, and the δ-phase. The compound MnNi is responsible for the δ-phase, and the compounds Mn_3Ni_2 and Mn_3Ni_4 (ε phase) probably occur. Cobalt and iron additions reduce considerably the degree of instability of the unstable system. Silicon accelerates the $\gamma \longrightarrow \delta$ transformation, which in these alloys proceeds slowly and only in a narrow interval of temperature.—H. S.

Kanthal. J. H. Russell (*Metallurgia*, 1932, **6**, 195–196).—A new electrical resistance material in which aluminium, chromium, and nickel are alloyed, and which is produced in 3 grades in which the permissible temperatures of heating elements made from them are 1325°, 1250°, and 1050° C., respectively. These alloys have a higher sp. resistance, and a lower sp. gr., than nickel–chromium alloys, and in the presence of sulphur are attacked only to a very small degree.

Kanthal alloys have also high oxidation-resisting qualities, and are produced in strips, castings, and wires. Elements made from these alloys have been used successfully in furnaces for hardening high-speed steel, glass-melting, heat-treating of stainless steel, case-hardening, enamelling, and sintering tungsten carbide.—J. W. D.

Investigation of the Magnetostriction and Magnetization of Single Crystals of the Iron–Nickel Series. Fritz Lichtenberger (*Ann. Physik*, 1932, [v], **15**, 45–71).—Single crystals of iron–nickel alloys with 30–100% nickel have been prepared in a vacuum furnace by Bridgman's method and their magneto-striction and magnetization measured. The direction in which the alloys are most readily magnetized is (100) for 30–70% nickel and (111) for 71–100% nickel.—v. G.

On the Equilibrium Diagram of the Nickel–Zinc System. Kanzi Tamaru (*Sci. Rep. Tôhoku Imp. Univ.*, 1932, [i], **21**, 344–363).—[In English.] The equilibrium diagram of the nickel–zinc system has been constructed from thermal analyses and dilatometric and electrical resistance measurements. The effect of zinc on the magnetic transformation of nickel has also been studied. The α solid solution extends to 61·61% nickel at 1403° C. The β solid solution on the zinc–rich side reaches 37·5% nickel at the eutectic temperature. The eutectoid transformation of the β solid solution occurs in alloys containing 45·1–24·4% nickel at a mean temperature of 675° C. The compound NiZn forms a δ solid solution which is homogeneous between 49 and 45·1% nickel. The reaction $\alpha + \beta \longrightarrow \delta$ occurs at 804° C. The compound $NiZn_3$ has a solubility of 1·4% nickel on the nickel side. The liquidus and eutectic horizontal near $NiZn_3$, found by differential thermal analysis, invali-date the view of Bauer and Hansen regarding the peritectic reaction. X-ray analysis shows that the structure of the α solid solution is face-centred cubic, that of β and δ hexagonal, and that of γ cubic.—E. S. H.

Magnetic Susceptibility and Electrical Resistance of the Palladium–Silver and Palladium–Copper Solid Solutions. Börje Svensson (*Ann. Physik*, 1932, [v], **14**, 699–711).—In the binary solid solution system silver–palladium the susceptibility falls from that of pure paramagnetic palladium to zero at 50 atomic-% silver and approximates to that of pure diamagnetic silver at 60 atomic-% silver. Copper–palladium solid solutions behave similarly. For the oriented compounds CuPd and Cu_3Pd the diamagnetic susceptibility is 50–100% greater than that for the unoriented solid solutions of the same composition.—v. G.

Electrical Properties of Dilute Solid Solution Alloys. II.—Resistance of Silver Alloys. J. O. Linde (*Ann. Physik*, 1932, [v], **14**, 353–366).—Cf. this *J.*, 1932, **50**, 15. The electrical conductivities of silver alloys with elements of atomic number 29–33, 46–51, and 78–83 have been determined. Solid solutions in silver of metals which do not belong to the transitional group follow Norbury's rule, which can be more precisely stated as follows : the atomic rise in resistance is proportional to the square of the distance (difference between the group numbers) of the element in the periodic system from the silver group.—v. G.

Mechanical Properties of White Bearing Metals at Various Temperatures. Anon. (*Metallbörse*, 1932, **22**, 1006–1007).—Tests on the resistance to wear of various types of bearing metal at 20–200° C. have been made in heavy motor lorries ; the results show the great superiority of the tin–rich alloys. Cad-mium–zinc and barium–calcium alloys are superior to the usual lead–rich alloys.—A. R. P.

High-Percentage Tungsten Carbide Alloys and their Technical Application. Sven G. Lind (*Teknisk Tids.*, Uppl. C., *Bergsvetenskap.* **62**, 1932, 9–14; *C Abs.*, 1932, **26**, 5532).—The manufacture of alloys of cemented tungsten carbide and cobalt and their mechanical properties are described. The

practical application of such alloys for cutting tools, dies for wire-drawing, and sand-blasting nozzles is discussed.—S. G.

On the Silicides of the Alkaline Earth Metals. Lothar Wöhler and W. Schuff (*Z. anorg. Chem.*, 1932, **209**, 33–59).—The preparation, identification, and properties of the compounds Sr_2Si_2, Ba_2Si_2, $SrSi_2$, $BaSi_2$, and $BaSi_3$ are described.—M. H.

Strength and Ductility of the Alloys of the " Noble " Metals. L. Sterner-Rainer (*Deut. Goldschmied.-Zeit.*, 1931, **34**, 114–115; *Chem. Zentr.*, 1931, **102**, I, 2667; *C. Abs.*, 1932, **26**, 4286).—The changes in properties which metals undergo in the process of working up are discussed. The relation of strength and ductility to the degree of stretching is especially noted, numerical expression of which has previously been considered unnecessary. This relation is of importance in judging the economy of working up of the metal.—S. G.

General Rules of the Changes of Structure and Properties During Transformation Processes. G. Sachs (*Z. Metallkunde*, 1932, **24**, 241–247; discussion, 247–248).—Read before the Deutsche Gesellschaft für Metallkunde. A transformation in alloys generally consists of two partial processes, viz., change of lattice structure and rearrangement of the atoms, and both of these can be studied separately by X-ray investigation and determination of the change of physical properties during ageing after quenching. Transformations are discussed involving (*a*) the change from random to regular distribution of the atoms in solid solutions ($AuCu_3$, $\beta \longrightarrow \beta'$ transformation in brass); (*b*) sudden change in lattice structure produced by gliding or slip (martensite transformation, $\beta \longrightarrow \alpha$ transformation in brass, $\beta \longrightarrow \alpha$ transformation of cobalt, $\beta' \longrightarrow \zeta$ transformation in silver–zinc alloys, formation of AuCu). The kinetics of lattice transformation are governed by one of three possibilities, viz., (1) thermal formation of nuclei and crystal growth (at high temperatures); (2) regular change of the lattice and crystal growth (at moderate temperatures): (3) regular change of the lattice alone (at lower temperatures). Numerous references are given.—M. H.

Transformation in Homogeneous Substances. G. Tammann (*Z. anorg. Chem.*, 1932, **209**, 204–212).—The nature of the reversible transformations in metals and alloys which take place in homogeneous phases (*i.e.* without recrystallization) is discussed with particular reference to: the magnetic transformations of iron, nickel, and solid solutions rich in these metals, the $\beta \rightleftharpoons \beta'$ transformation in copper–zinc alloys, and the transformation of the alloy Cu_3Au.—M. H.

III.—STRUCTURE

(Metallography; Macrography; Crystal Structure.)

Structure of Polished Solids. L. Hamburger (*Nature*, 1932, **130**, 435–436).—A review of recent literature leads to the view that polishing should be considered primarily as a process of abrasion, accompanied by levelling of surface lamellæ. It is considered that the first step in this direction has already been made during the grinding of the specimen. Delicate polishing involves a dragging of minute particles (containing from 3 to 40 atoms in most common, hard metals) along the surface and filling up existing pits. Thus, a surface film, differing from the underlying material, is produced.—E. S. H.

On the Theory of Recrystallization. E. F. Bachmetew, A. A. Botchvar, G. S. Zhdanov, and Y. S. Umansky (*Zhurnal Tehnicheskoy Fiziki* (*Journal of Technical Physics*), 1932, [B], **2**, (2), 161–172).—[In Russian.] The phenomenon of recrystallization of metals is examined in the light of modern scientific conceptions of atomic structure. Recrystallization of a deformed single crystal is considered in detail. The hypothesis of different types of " nuclei " is dis-

cussed as well as of two types of "recovery." The typical elements of recrystallization, irregularities in the distribution of internal stress, and changes in structure are systematized. The recrystallization of a true polycrystalline aggregate is analyzed.—N. A.

On the Corrections for Debye-Scherrer X-Ray Photographs. Zenji Nishiyama (*Sci. Rep. Tôhoku Imp. Univ.*, 1932, [i], **21**, 364–384).—[In English.] Different correction formulæ for the thickness of the specimen have been applied to experiments with Armco iron and aluminium (99·95%); the formula proposed by N. appears to be the most satisfactory. The *lattice constant for aluminium* is determined as 4·041 A.—E. S. H.

The Crystal Structure of AuCd. Arne Ölander (*Z. Krist.*, 1932, **83**, 145–148).—[In English.] The dimensions of the elementary cell of AuCd, as determined by X-ray analysis, are as follows : a 3·144, b 4·851, c 4·745 A. The density of the alloy is 14·5. At temperatures above 267° C. (the transition temperature) the alloy has the same structure as the corresponding phases in the gold–zinc and copper–zinc systems.—E. S. H.

Crystal Structure of Electrodeposits from Copper Acetate Solutions. S. J. M. Allen, H. Kersten, and Joseph Maas (*Physics*, 1932, **3**, 169–171).—Electrodeposits from copper acetate solutions are shown, by X-ray analysis, to consist principally of a mixture of crystals of copper and cuprous oxide. The proportion of the latter increases with decrease of acidity of the bath. Rectifying or photo-electric properties are not possessed by the deposits.—J. T.

On the Lattice Dimensions of Niobium (Columbium), Tantalum, and Some Niobates and Tantalates. Laurence L. Quill (*Z. anorg. Chem.*, 1932, **208**, 257–272).—The crystal structure of niobium (columbium) of spectroscopic purity and tantalum (99·9%) has been determined by the powder method. Both metals have a cubic body-centred lattice with $a = 3·299 \pm 0·001$ A., $d_{calc.} = 8·575$, atomic radius ($8 =$ co-ordination) $= 1·429$ A. for niobium, and $a = 3·298 \pm 0·002$ A., $d_{calc.} = 16·69$, atomic radius $= 1·428$ A. for tantalum.—M. H.

X-Ray Investigations of Metallic Lanthanum, Cerium, and Neodymium. Laurence L. Quill (*Z. anorg. Chem.*, 1932, **208**, 273–281).—Lanthanum has a hexagonal lattice, $a = 3·57_4 \pm 0·010$ A., $c = 6·06_3 \pm 0·030$ A., $c/a = 1·613$, $d_{calc.} = 6·194$, atomic radius $= 1·870$ A., cerium a cubic face-centred lattice $a = 5·143 \pm 0·004$ A., $d_{calc.} = 6·799$, and neodymium a hexagonal close-packed lattice, $a = 3·65_7 \pm 0·010$ A., $c = 5·88_0 \pm 0·030$ A., $c/a = 1·608$, $d_{calc.} = 6·991$.—M. H.

X-Ray Study of the Plastic Working of Magnesium Alloys. L. G. Morell and J. D. Hanawalt (*Physics*, 1932, **3**, 161–168).—The structure of Dowmetal (alloys containing various proportions of aluminium, zinc, manganese, and other elements together with magnesium of purity 99·9%) worked by various processes, *e.g.* forging, rolling, extruding, and drawing, has been investigated by X-ray analysis. Three distinct structures are found, *viz.*, (1) a [210] fibre structure at ordinary temperatures and (2) a [110] fibre structure at temperatures above 450° C. with the fibre axis in both cases in the direction of drawing or extrusion, and (3) a [001] fibre structure with the fibre axis in the direction of forging. The difference in the structure of metal extruded at low and high temperatures is discussed in terms of the glide systems of magnesium.
—J. S. G. T.

Crystal Structure of Black Nickel. H. Kersten and Joseph Maas (*Physics*, 1932, **3**, 137–138).—X-ray analysis shows that electrodeposited black nickel has an amorphous structure which changes to a crystalline structure when the deposit is heated.—J. S. G. T.

The Structure of Nickel–Zinc Alloys.—I. W. Heike, J. Schramm, and O. Vaupel (*Metallwirtschaft*, 1932, **11**, 525–530, 539–542).—Vacuum-melted alloys with 44–100% nickel have been examined röntgenographically, thermally, and micrographically. The solubility of zinc in nickel is 44% at 1050° C.,

36% at 800° C., and 34% at 500° C. and lower.   The β_1-phase with 50–54·2% zinc is tetragonal, $a = 2\cdot754$ A., $c = 3\cdot214$ A.; the structure consists of two simple tetragonal lattices based on nickel at (000) and zinc at $(\frac{1}{2}\,\frac{1}{2}\,\frac{1}{2})$. β_1 is converted into cubic β ($a = 4\cdot112$ A.) over the range 810° C. (50% nickel) to 640° C. (54% nickel); this phase has a sodium chloride type of lattice and exists in alloys up to 60% nickel, but cannot be supercooled.   The microstructure of the alloys can be varied very considerably according to the composition and heat-treatment in agreement with complex equilibrium diagrams.—v. G.

On the System Tungsten–Cobalt.   Curt Agte, Karl Becker, and (Frhr.) von Göler (*Metallwirtschaft*, 1932, **11**, 447–450).—Cobalt is soluble in tungsten to the extent of about 10 atomic-% and tungsten in cobalt to about 8 atomic-%. The system contains only one intermediate phase with 52–63 atomic-% cobalt, which is non-magnetic on the tungsten side, but becomes magnetic with increasing cobalt content; its crystal structure has not been elucidated, but is certainly not cubic.—v. G.

The Crystal Structure of Yttrium.   Laurence L. Quill (*Z. anorg. Chem.*, 1932, **208**, 59–64).—Yttrium (>99·5%) has a close-packed hexagonal lattice with two atoms in the elementary cell, $a = 3\cdot663 \pm 0\cdot008$ A., $c = 5\cdot814 \pm 0\cdot012$ A., $c/a = 1\cdot588$; atomic radius $= 1\cdot814$ A., $d_{\text{calc.}} = 4\cdot34$.—M. H.

X-Ray Determination of the Solubility of Cadmium in Zinc.   W. Boas (*Metallwirtschaft*, 1932, **11**, 603–604).—Determinations made on specimens homogenized for 8–14 days gave the following values for the solubility of cadmium in zinc : 1·8% at 250°, 1·1% at 218°, 0·35% at 156°, and less than 0·1% at 100° C.—v. G.

On Variations of Interatomic Distances with the Change from the Cubic Face-Centred Arrangement to the Cubic Body-Centred or to the Hexagonal Close-Packed Lattice.   H. Perlitz (*Trans. Faraday Soc.*, 1932, **28**, 514–518).— Existing data on the interatomic distances at the transition from the cubic face-centred to the cubic body-centred lattice indicate that there is a decrease of 2·25% in the distance between the atoms during the change.   In the change from cubic to close-packed hexagonal lattice the change in interatomic distances decreases to zero as the axial ratio of the hexagonal lattice approaches 1·633.
—A. R. P.

Concerning the Structure Factor.   W. Neskutchaev (*Zhurnal eksperimentalnoy i teoreticheskoy Fiziki (Journal of Experimental and Theoretical Physics*), 1932, [A], **2**, (3), 171–178).—[In Russian.]   A simple vector method is described for determining the distribution of the atoms within the space lattice by means of the intensity of the X-ray spectral lines reflected from the crystal surface.—N. A.

Diffraction of X-Rays by Liquid Metals.   J. T. Randall and H. P. Rooksby (*Nature*, 1932, **130**, 473–474).—Liquid sodium, potassium, rubidium, and cæsium at temperatures slightly above the melting point give X-ray diffraction spectra consisting of a single, sharply-defined, narrow band, the position of which is approximately the same as that of the strongest line of the corresponding solid metal.   The result suggests that the liquids contain groups of molecules which tend to become oriented in a way resembling the crystalline space-lattice.—E. S. H.

On the Importance of X-Ray Interference Lines in the Study of Metals. E. Schmid (*Naturwiss.*, 1932, **20**, 530–536).—The value of X-rays in elucidating the atomic and crystallographic structure of metals and alloys and the effect thereon of heat and mechanical treatment is reviewed.—J. W.

Lattice Forces and X-Ray Spectrum.   R. Glocker (*Naturwiss.*, 1932, **20**, 536–539).—The position of the K-absorption edges of a given kind of atom is somewhat changed by the action of several factors during transformation into another kind of lattice structure.   With the same type of lattice in different alloys the wave-length of the K-edge is a linear function of the lattice energy.

With the same lattice energy but different types of lattice the K-edge in ionic lattices and their transition forms has a wave-length which is shorter the larger the co-ordination number. If the valence, lattice energy, and co-ordination number are the same the K-edge is displaced towards longer wave-lengths in the transition from heteropolar to homopolar or metallic linkages. Furthermore, the occurrence of discontinuities in the short-wave portion of the absorption spectrum is attributed to the action of lattice linkages even in metals; they have not been observed in the spectrum of the vapour. Some observations on the displacement of lines of the emission spectrum during change of the lattice linkages are discussed on the basis of recent research.
—J. W.

The Interaction of Lattice Vibrations and Free Electrons in Metals. H. Jones (*Proc. Cambridge Phil. Soc.*, 1932, **28**, 367–385).—A mathematical treatment.—E. S. H.

X-Ray Scattering and Atomic Structure. E. O. Wollan (*Rev. Modern Physics*, 1922, **4**, 205–258).—From the point of view of this *Journal* this paper is of importance in so far as the structure factor is required for the interpretation of the intensities of reflection of X-rays by crystals. A general review is given of previous theoretical and experimental investigations of the intensity of scattered X-rays as related to the determination of the structure factors, and the electron distribution of atoms. W. deals essentially with existing knowledge, which does not call for abstraction, but gives a very clear account of the subject together with a comprehensive bibliography.—W. H.-R.

IV.—CORROSION

Corrosion Researches on Pure Aluminium and Aluminium Alloys in Contact with Different Heavy Metals in 3% NaCl Solution. —— Zurbrügg (*Light Metals Research*, 1932, **2**, (13), 13).—Tests carried out for 3, 6, and 9 months on pairs of plates, made by riveting together various combinations of light metals among themselves and with heavy metals, and immersed in 3% solution of sodium chloride, gave no positive results. The electro-negative metals corroded only at the points at which they came in contact with the electro-positive metals, the remaining surface of the electro-negative metals being covered with a dense oxide protective film.—J. C. C.

Properties of Aluminium in Apparatus. T. Hoffmann (*Korrosion* (Suppt. to *Chem. Apparatur*), 1931, **6**, 13; *C. Abs.*, 1932, **26**, 5047).—Copper salts, even in dilute solution, cause corrosion in aluminium vessels. Agar-agar or gum arabic affords better protection than sodium silicate against sodium hydroxide, but the reverse is true with sodium carbonate. Bleaching liquor is rendered inactive by the addition of hydrogen peroxide. Duralumin particles which get in during rolling cause corrosion.—S. G.

Occurrence and Determination of Aluminium in Foods. II.—Aluminium Content of Foodstuffs Cooked in Glass and in Aluminium. George D. Beal, Richard B. Unangst, Helen B. Wigman, and Gerald J. Cox (*Indust. and Eng. Chem.*, 1932, **24**, 405–407).—The results of other investigations of the corrosion of aluminium by foodstuffs are reviewed, and alternative methods considered. The authors adopt the method of analyzing foods for aluminium rather than that of carrying out corrosion tests on metal samples : analyses of foods cooked in aluminium vessels are compared with those obtained using Pyrex utensils. The amount of aluminium dissolved is negligible with foods of neutral reaction, somewhat higher with acid foods, but in no case does it approximate to the amount required to interfere with phosphorus absorption. If all foods are cooked in aluminium vessels, the amount of aluminium ingested daily is about 12 mg., and of this only about 5 mg. is derived from cooking utensils.—P. M. C. R.

Corrosion Fatigue [of Aluminium Alloys] and Anodic Oxidation. Kurt Matthaes (*Light Metals Research*, 1932, **2**, (10), 2–5).—A translation of an extract dealing with the effect of anodic oxidation on the corrosion fatigue of Duralumin " 681 ZB " from Report No. 250 of the Deutsche Versuchsanstalt für Luftfahrt E.V.—J. C. C.

Corrosion [of Aldrey and Avional D] under Prolonged Load. —— Irmann and W. Müller (*Light Metals Research*, 1932, **2**, (14), 18).—The residual elongations of wires of Aldrey and Avional D were found to be reduced after corrosion in 3% sodium chloride and to be still more reduced after corrosion under a prolonged load. The elastic limits are thus apparently raised by these treatments.—J. C. C.

Corrosion Tests on Coloured Cadmium Deposits. H. Krause (*Mitt. Forschungsinst. Edelmetalle*, 1932, **6**, 50–54).—Dark deposits obtained by immersion in a bath containing copper salts are rapidly and completely destroyed in the salt-spray test, whereas those produced in permanganate–cadmium nitrate baths are much more resistant. The former type of deposit owing to its copper content tends to reduce the rust-protecting power of cadmium-plate, whereas the latter type is without effect thereon. Lacquering or impregnating the coloured deposits with wax does not improve their resistance to weathering.
—A. R. P.

Corrosion of [Cadmium–Zinc] Alloys. Johan Gørrissen (*Kgl. Norske Videnskab. Selskab. Forh.* **4**, 1931, 169–171; *C. Abs.*, 1932, **26**, 4577).—The corrodibility of various cadmium–zinc alloys by N-sodium hydroxide was investigated. So long as the zinc is present as a eutectic, the cadmium protects well. If zinc is increased until primary zinc crystals are present, the cadmium accelerates corrosion. The oxygen concentration was found to be of great importance. Investigations carried out on the corrosion of cadmium–magnesium alloys in $0.01N$-hydrochloric acid appear to bear out the correctness of Tammann's theory of the resistance limits. Three distinct types of corrosion were shown, corresponding to : (1) alloys with more than 50 atomic % cadmium; (2) alloys with 20–50 atomic % cadmium, and (3) alloys with less than 20 atomic % cadmium.—S. G.

Recent Investigations on the Atmospheric Corrosion of Copper. W. H. J. Vernon (*Korrosion u Metallschutz*, 1932, **8**, 141–147).—A review of the recent work of the author and his collaborators.—A. R. P.

Corrosion of Copper. Oxide Protective Films in Salt Solutions. W. Haase (*Metallwirtschaft*, 1932, **11**, 516, 530–531, 556–557).—The behaviour of copper in solutions of alkali salts under electrochemical attack has been investigated with especial reference to the conditions under which homogeneous, non-porous, adherent protective oxide films can be produced by aeration. The best results are obtained in solutions of sodium salts in which the current rapidly falls to zero. The colour of the film is yellow at the beginning of the treatment, but rapidly turns to black. In solutions of potassium salts, other than the nitrite and nitrate, film formation is much slower. Ammonium salts form films very slowly, and the process is complicated by the formation of complex salts.—v. G.

Turbine Blade Deterioration. D. G. McNair (*Marine Eng. Officers' Mag.*, 1932, **13**, 188–190).—Satisfactory turbine blading should, under modern service conditions, which may include a steam pressure of 550 lb./in.^{2} and a temperature of 750° F. (400° C.), retain a correct contour, strongly defined inlet and outlet angles, and smooth surface. These properties must be combined with easy manufacture and cheap production. After consideration of the service conditions resulting in corrosion and erosion, the relative advantages of special steels, brass, phosphor–bronze, nickel–bronze, mild steel, and Monel metal are considered. It is stated that their performance and durability under superheat conditions justifies the extra cost of Monel metal blades.—P. M. C. R.

The Chamber Process. XXIV.—Corrosion Test of Sheet Lead by Sulphuric Acid. Mototarō Matsui and Hirondo Katō (*Kogyo Kwagaku Zasshi (J. Soc. Chem. Ind., Japan*), 1932, **35**, (7)).—[In Japanese, with English summary in supplemental binding.] Determinations were made, on the samples described in Part XXIII (see *J.*, this volume, p. 2), of the rate of corrosion at 52° C. in 74·24% sulphuric acid and in similar acid containing 1·66% of nitrogen trioxide. The presence of the trioxide increased the rate of corrosion owing to its solvent effect on the lead sulphate film which forms on the surface of the metal. Antimonial lead was much more seriously attacked than any of the other samples in nitrous sulphuric acid and in the gases in the flue joining the last chamber to the Gay-Lussac tower. Annealing at 100° C. increased the rate of corrosion of all the samples.—A. R. P.

Electrolytic Corrosion of Lead Cable Sheathing. M. Horioka and T. Kyōgoku (*Res. Electrotech. Lab. Tokyo*, No. **323**, 1931, 1–49; *Sci. Abs.*, 1931, [B], **35**, 182).—[In Japanese, with English synopsis.] The corrosion of lead and alloys used for cable sheathing was studied for a number of electrolytes and at different current densities. It was shown that the formation of lead peroxide took place when the density of the corrosive currents and the concentration of the electrolytes were beyond a certain limit. The formation of lead peroxide caused some slight protection against further action. Electrolytic corrosion was specially noticeable in solutions of acetic acid and calcium hydroxide. It is considered that this is due to intercrystalline corrosion followed by mechanical disintegration of the crystal grains. In view of this, special caution is necessary in ageing concrete ducts prior to use.—S. G.

On the Kinetics of the Dissolution of Magnesium and other Metals in Aqueous Solutions. B. F. Ormont (*Zhurnal Fizicheskoy Khimii (Journal of Physical Chemistry*), 1932, [W], **3**, (1), 108–120).—[In Russian.] The rate of dissolution of magnesium in solutions of hydrochloric acid and ammonium salts has been investigated. It is shown that the Noyes–Nernst equation for the case of a metal dissolving in water and aqueous solutions does not apply. The passivity of magnesium in distilled water is probably explained, not by the formation of the sparingly soluble hydroxide on the metal surface, but by the extremely strong bond between this layer of hydroxide and the metal. The mechanism of the ionic reaction between magnesium and solutions is also examined.—N. A.

Cause and Prevention of Some Black Spots which Appeared on Cloth after Kier Boiling. Albert H. Grimshaw (*Textile Colorist*, 1932, **54**, 466; *C. Abs.*, 1932, **26**, 5211).—Black spots of stannous oxide are attributed to tin rust on the tin rollers of the looms. During the Kier boiling, the stannic anhydride is reduced to stannous oxide.—S. G.

The Kinetics of the Conversion of Ions of Metals into Neutral Atoms under the Influence of Metallic Zinc. M. Centnerszwer and W. Heller (*Z. physikal. Chem.*, 1932, [A], **161**, 113–128).—In the dissolution of zinc in copper sulphate solution the velocity constant K increases with the rate of stirring between 50 and 400 revolutions/minute, and is independent thereof at 400–700 revolutions/minute, as the rate of diffusion is then equal to the rate of reaction. Between 0° and 50° C. K increases proportionally with the temperature to the same extent as the diffusion coeff., from which it follows that the thickness of the adherent copper sulphate solution film is independent of the temperature. The above facts indicate that the dissolution of zinc in copper sulphate solution is purely a diffusion process. The anions CNS', Cl', and SO_4'' accelerate, and the anion NO_3' retards, the reaction strongly. Organic acids and colloids slow down the reaction, the latter because they adsorb the metal precipitate on the zinc. Amalgamated zinc dissolves somewhat more rapidly than ordinary zinc. Practically no zinc dissolves in nickel sulphate solutions, but

the zinc plate becomes covered with a precipitate. The rate of dissolution of zinc in silver sulphate solution is greater than that in copper sulphate solution, whilst that in silver nitrate solution decreases with time. There is only a qualitative relationship between the mutual replacement velocities of metals and their position in the electrochemical series.—B. Bl.

Corrosion of Metals by Tan Liquors. III.—Corrosion of Submerged Metals in Movement. M. P. Balfe and H. Phillips (*J. Internat. Soc. Leather Trades Chem.*, 1932, 16, 345–353; *C. Abs.*, 1932, 26, 4576).—Cf. this *J.*, 1932, 50, 547. Tan liquors of various types were stirred mechanically for 160 hrs. with test-pieces of iron, copper, aluminium, nickel and numerous brasses, bronzes, and ferrous alloys. The liquors were examined for change in colour and dissolved metals, and the test-pieces were examined for pitting. Iron-chromium–nickel alloys ("stainless" steels) were practically unattacked; all other metals and alloys tested were appreciably attacked, especially in liquors containing sulphur dioxide.—S. G.

Corrosion in a Pacific Coast Groundwood Mill System. I. H. Andrews (*Pacific Pulp Paper Ind.*, 1932, 6, (6), 16–17; *C. Abs.*, 1932, 26, 4713).— Closed-in white-water systems apparently build up an acidity, which in turn introduces a corrosion problem. Corrosion may be combated by partial neutralization, but when the p_H is brought above 5·5 with sodium carbonate there is danger of discoloration of the pulp. Corrosion tests carried out by subjecting test-specimens of various materials to the splashing of hot spruce pulp at the grinder showed that wrought-iron pipe is much more resistant than wrought-steel pipe, and that certain acid-resisting metals (particularly when polished) have a satisfactory resistance. Use of wood stave piping and copper fittings has practically eliminated corrosion and iron pick-up in one 100-ton groundwood mill.—S. G.

Notes on Some Chemical and Physical Phenomena [of Interest to the Brewing Industries]. —— Bourgeois (*Bull. assoc. élèves inst. sup. fermentations Gand*, 1932, 32, 119–127; *C. Abs.*, 1932, 26, 4409).—An address discussing briefly, especially from the physical point of view, the influence of hardness of water, metal corrosion, &c., as they affect the brewing industry.
—S. G.

Chemical and Micro-Biological Action of Sea-Water in Causing Alterations of Metals. H. Masseille (*Peintures, pigments, vernis*, 1932, 9, 117–118; *C. Abs.*, 1932, 26, 5057).—Although near the shore bacteria are a more or less important factor in the decomposition of protective coatings and the corrosion of metallic objects, the water of the ocean is so nearly sterile that on the high seas corrosion is due almost entirely to strictly chemical action.—S. G.

The Prevention of Corrosion-Fatigue by [Surface Consolidation under] Pressure. A. Thum and H. Ochs (*Z. V.d.I.*, 1932, 76, 915–916).—The deleterious effect of corrosion on the endurance strength of metals under alternating stresses is accounted for on the supposition that the alternating loads continuously open and close minute cracks in the surface of the metal, thus allowing the corrosive liquid to penetrate readily into the interior. By closing up the surface cracks of specimens under pressure between rolls, an improvement of 50% has been made in the endurance bending strength of steels.—v. G.

A Modern Soil Survey with Shepard Rods. Arthur B. Allyne (*Gas Age-Record*, 1931, 68, 269–272, 282).—The use of Shepard electrodes, recently developed by the [U.S.] Bureau of Standards in a survey of soil corroding properties over an extensive area in south-western U.S.A. is described. The electrodes have been found suitable for use in alkaline soils. Their use makes it possible to predict the life of buried steel pipe and to predetermine the necessary protection.—J. S. G. T.

V.—PROTECTION

(Other than Electrodeposition.)

Protection of Aluminium or Its Alloys. [Ch. Boulanger] (*Usine*, 1931, **40**, (3), 33).—Abstract of a paper read at the Congrés International de Sécurité Aérienne, 1930. The method recommended is to immerse the sample in a boiling, feebly alkaline, solution of metallic salts such as vanadates, molybdates, tungstates, titanates, uranates, manganates, chromates, either singly or mixed. The time of immersion does not exceed half an hour.—H. H.

Anodic Oxidation of Aluminium. Anon. (*Aluminium Broadcast*, 1932, **3**, (37), 10–16; and *Met. Ind. (Lond.)*, 1932, **41**, 395–396).—A memorandum issued by the Intelligence Department of the British Aluminium Company, Ltd., describing the so-called Bengough process for protecting aluminium and its alloys by anodic oxidation.—J. H. W.

The Chemical Oxidation of Aluminium and its Alloys. W. L. (*Light Metals Research*, 1932, **2**, (4), 8 pp.).—Chemical processes for thickening the oxide film on aluminium are complex in character and in general depend on the hydrolysis of a salt, usually with the help of a catalyst. The films so formed are slightly hygroscopic, and their hardness and dielectric strength are much less than for anodic films. The properties may be modified by oxides, salts, or mordants and basic dyes, which are readily adsorbed. The films are chiefly used for decoration (after colouring), corrosion protection, and heat insulation. Brief details with full patent references of eight immersion processes are tabulated, and there is a short bibliography.—J. C. C.

Oxidized Aluminium. Anon. (*Woch. Brau.*, 1932, **49**, 253; *J. Inst. Brewing*, 1932, **38**, 481).—A protective oxide film is produced on the surface of aluminium by the "Eloxal" process. This film consists of a very finely crystallized form of alumina which has nearly the hardness of carborundum and is not attacked by boiling water. On pure aluminium, it has a straw-yellow colour, but any required tint can be given by means of oil-soluble colours. The resistance to corrosion can be further increased by a mechanical after-treatment which closes any pores in the film. The film is an electrical insulator and has ten times the heat-radiating power of ordinary aluminium. The process has already been applied for various electrical and thermo-technical purposes.—H. W. G. H.

Investigation of the Process of Saturation of Iron and Steel by Aluminium in Liquid Alloys of Aluminium and Iron in order to make them Heat-Resistant. F. T. Nikonov (*Niimash Izvestia Nauchno-issledovatelskogo Instituta Mashinostroenia i Metalloobrabotki (Bulletin of the Scientific Research Institute of Machine Building and Metal Treatment)*, **1932**, (4), 181–201).—[In Russian.] The alloy which must be used for the process of calorizing has an iron content of 6–8%. The maximum rate of diffusion of aluminium into iron occurs in this alloy at temperatures between 750° and 800° C. Aluminium diffuses more easily into ferrite than into austenite at the same temperature, the carbon impeding diffusion in the latter case. The optimum duration of treatment is 45–60 minutes. On conclusion of the process, annealing at 1100°–1150° C. is necessary.—N. A.

Determination of the Thickness and Quality of Protective Coatings on Galvanized Iron. R. Vondracek (*Congrès internat. mines, Liége*, **1930**, June 22–28; and *Métallurgie*, **1930**, 547–554; *Chim. et Ind.*, 1932, **27**, 1077; *C. Abs.*, 1932, **26**, 4284).—Preece's method, consisting in determining the time required to dissolve the coating in a neutral saturated solution of copper sulphate frequently does not give consistent results. V. suggests determining the rate of solution of the coating by measuring the volume of hydrogen evolved in dilute acid solution. In a few minutes it is possible to establish solution curves that determine the structure of the coating with an accuracy

that frequently exceeds that of micrographic examination. V. describes a series of experiments carried out on galvanized irons under varying conditions of temperature, concentration, etc. Wires 10 cm. long were immersed in N-sulphuric acid and the volume of hydrogen evolved was measured at 1 minute intervals. The quality of the coating can thus be gauged by means of : (a) the total volume of hydrogen evolved with 100 c.c. of acid; (b) the total time and the mean rate of evolution of gas; (c) the maximum rate of evolution of hydrogen and its position on the curve; (d) the ratio of maximum to average rate of evolution; (e) the fraction of the total time required for evolution of 50% of the gas. Total time of evolution is defined as the time required for evolution of 95% of the total gas. It was observed that the ratio of maximum to average rate of evolution and the relative time for evolution of 50% of the gas do not vary appreciably with change in temperature.—S. G.

Tentative Revisions of A.S.T.M. Standards. Standard Specifications for Zinc-Coated (Galvanized) Iron or Steel Telephone and Telegraph Line Wire (A 111–30). —— (*Amer. Soc. Test. Mat. Tentative Standards*, 1932, 1128).— A revision in the form of separate tentative specifications (see following abstract) is intended to replace, when adopted, the present standard specifications.—S. G.

Tentative Specifications for Zinc-Coated (Galvanized) Iron or Steel Telephone and Telegraph Line Wire (A 111–32 T). —— (*Amer. Soc. Test. Mat. Tentative Standards*, 1932, 136–141).—Cover galvanized iron or steel wire suitable for use in telephone, telegraph, and signal transmission where electrical characteristics of the wire are important. The zinc used for the coating must be any grade of zinc conforming to " Standard Specifications for Slab Zinc (Spelter) " (B 6). The weight of zinc coating for wires 0·109 in. in diam. and larger must not be less than 0·8 oz./ft.^{2} of uncoated wire surface. The weight of coating for wire 0·083 in. in diam. shall not be less than 0·7 oz./ft.^{2}. The zinc coating must be tested for weight by a stripping test in accordance with " Standard Methods of Determining Weight of Coating on Zinc-Coated Articles " (A 90). The uniformity of the zinc coating is to be determined by the Preece test as described in the appendix to the last-mentioned specification (A 90). A wrapping test is specified for the determination of the adherence of the coating. The requirements as to base metal, joints, sampling, and the tensile strength, elongation, twists, electrical resistivity, size and permissible variations, of the galvanized wire, workmanship and finish, &c., are set forth.—S. G.

Tentative Revisions of A.S.T.M. Standards. Standard Specifications for Zinc-Coated (Galvanized) Iron or Steel Tie Wires (A 112–30). —— (*Amer. Soc. Test. Mat. Tentative Standards*, 1932, 1128).—A revision in the form of separate tentative specifications (see following abstract) is intended to replace, when adopted, the present standard specifications.—S. G.

Tentative Specifications for Zinc-Coated (Galvanized) Iron or Steel Tie Wires (A 112–32 T). —— (*Amer. Soc. Test. Mat. Tentative Standards*, 1932, 142–145).—Cover the wire used for tying galvanized telephone and telegraph wire to insulators. The requirements as to zinc used, weight of coating, uniformity of coating, adherence of coating, are as for Tentative Specification No. A 111–32 T) (see abstract above).—S. G.

Tentative Revisions of A.S.T.M. Standards. Standard Specifications for Zinc-Coated (Galvanized) Iron or Steel Farm-Field and Railroad Right-of-Way Wire Fencing (A 116–30). —— (*Amer. Soc. Test. Mat. Tentative Standards*, 1932, 1128).—A revision in the form of separate tentative specifications (see following abstract) is intended to replace, when adopted, the present standard specifications.—S. G.

Tentative Specifications for Zinc-Coated (Galvanized) Iron or Steel Farm-Field and Railroad Right-of-Way Wire Fencing (A 116–32 T). —— (*Amer.*

Soc. Test. Mat. Tentative Standards, **1932,** 146–149).—The zinc used must be any grade conforming to the requirements of " Standard Specification for Slab Zinc (Spelter)" (B 6). The weight of zinc coating must not be less than that specified by the purchaser; the weight of coating commercially available on the various gauges of wire used is indicated. The zinc coating is to be tested for weight by a stripping test in accordance with " Standard Methods of Determining Weight of Coating on Zinc-Coated Articles " (A 90). The uniformity of zinc coating is to be determined by the Preece test as described in the appendix to the last-mentioned specification (A 90). The number of dips that commercially available weights of coatings on wires of various diameters will stand without failure are set forth for both types of fencing.—S. G.

Tentative Revisions of A.S.T.M. Standards. Standard Specifications for Zinc-Coated Iron or Steel Chain-Link Fence Fabric Galvanized After Weaving (A 117–30). ——— (*Amer. Soc. Test. Mat. Tentative Standards,* **1932,** 1128).— A revision in the form of separate tentative specifications (see following abstract) is intended to replace, when adopted, the present standard specifications.—S. G.

Tentative Specifications for Zinc-Coated Iron or Steel Chain-Link Fence Fabric Galvanized After Weaving (A 117–32 T). ——— (*Amer. Soc. Test. Mat. Tentative Standards,* **1932,** 150–152).—Covers zinc-coated chain-link fence fabric, galvanized after weaving, in which the individual pickets are helically wound and interwoven in the form of a continuous link fabric without knots or ties. The zinc used for the coating must be any grade conforming to " Standard Specifications for Slab Zinc (Spelter) " (B 6). The weight of coating on the wire is not to be less than 1·2 oz./ft.² of uncoated wire surface. The zinc coating is to be tested for weight by a stripping test in accordance with " Standard Methods of Determining Weight of Coating on Zinc-Coated Articles " (A 90). The uniformity of the coating is to be determined by the Preece test as described in the appendix to the last-mentioned specification (A 90). Coatings must stand without failure 5 dips of 1 minute each.—S. G.

Tentative Revisions of A.S.T.M. Standards. Standard Specifications for Zinc-Coated (Galvanized) Iron or Steel Barb Wire (A 121–30). ——— (*Amer. Soc. Test. Mat. Tentative Standards,* **1932,** 1128).—A revision in the form of separate tentative specifications (see following abstract) is intended to replace, when adopted, the present standard specifications.—S. G.

Tentative Specifications for Zinc-Coated (Galvanized) Iron or Steel Barb Wire (A 121–32 T). ——— (*Amer. Soc. Test. Mat. Tentative Standards,* **1932,** 153–155).—Cover galvanized iron or steel barb wire in which the zinc is zinc coated before or after fabrication. The zinc used must be any grade of zinc conforming to " Standard Specifications for Slab Zinc (Spelter) " (B 6). The weight of zinc coating on any individual wire shall not be less than specified by the purchaser; the weight of coating commercially available on the following wire is 0·30 oz. (min.)/ft.² of uncoated wire surface : 0·1055 in diam., 12 gauge; 0·0985 in. diam., 12½ gauge; 0·080 in. diam., 14 gauge. The zinc coating is to be tested by a stripping test in accordance with " Standard Methods of Determining Weight of Coating on Zinc-Coated Articles " (A 90), and the uniformity of the coating is to be determined by the Preece test as described in the appendix to the same specifications (A 90). Coatings for the 3 sizes of wire above-mentioned shall stand without failure 1 dip of 1 minute and 1 dip of 20 seconds.—S. G.

Tentative Revisions of A.S.T.M. Standards. Standard Specifications for Zinc-Coated (Galvanized) Iron or Steel Wire Strand (A 122–30). ——— (*Amer. Soc. Test. Mat. Tentative Standards,* **1932,** 1129).—A revision in the form of separate tentative specifications (see following abstract) is intended to replace, when adopted, the present standard specifications.—S. G.

Tentative Specifications for Zinc-Coated (Galvanized) Iron or Steel Wire Strand (Cable) (A 122–32 T). ——— (*Amer. Soc. Test. Mat. Tentative Standards,*

1932, 156–161).—Cover galvanized iron or steel wire strand, composed of a multiplicity of wires, and suitable for use as guy wires, messenger wires, span wires, electrical conductors, overhead ground wires, &c. The zinc used for the coating must be any grade conforming to " Standard Specifications for Slab Zinc (Spelter) " (B 6). The nominal diameters and minimum weights of coating for galvanized steel wires are set forth in a table. The zinc coating is to be tested for weight by a stripping test in accordance with " Standard Methods of Determining Weight of Coating on Zinc-Coated Articles " (A 90), and the uniformity of the coating is to be determined by the Preece test as described in the appendix to the same specifications (A 90). The number of dips that " galvanized " and " extra-galvanized " or " double galvanized " wires of various diameters shall stand without failure are given for wires of 5 diameters. A wrapping test is specified for determining the adherence of the coating, and a table sets forth the requirements as to physical properties of the galvanized wire strand.—S. G.

Metal Spraying. Walter Hahn (*Z.V.d. Kupferschmied.*, 1932, **44**, 139–140, 154–156).—A general review.—M. H.

[**Metal Spraying.**] **Machine-Gun Bullets of Peace.** L. E. Kunkler (*Welding Eng.*, 1932, **17**, (6), 24–25).—Brief non-technical description of the metal spraying process.—H. W. G. H.

Metal Foil Lacquers and their Commercial Uses. —— Stühlinger (*Ind. Lack. Betr.*, **1931**, (14), 203; *Nitrocellulose*, 1932, **3**, 85; *C. Abs.*, 1932, **26**, 4485).—Satisfactory results have been obtained with nitrocellulose lacquers for metal foil, instead of alcoholic shellac solutions. Oil must be removed before lacquering. Metal pressure rolls are generally used, because the solvents attack rubber rolls. 1 kg. of lacquer is sufficient for 3–4 kg. of 0·009 mm. foil.—S. G.

A Chemical De-Scaler. Anon. (*Colliery Eng.*, 1932, **9**, 276).—An account is given of Starit, a scale solvent containing mineral acid, the action of the latter on metals being almost entirely inhibited by organic additions. The normal time required for scale removal is stated to be 6 hrs., but it is claimed that in less than 48 hrs. the action on aluminium, solder, and other readily attacked metals is inappreciable.—P. M. C. R.

Rubber-Lined Centrifugal Pumps. Anon. (*Indian Eng.*, 1932, **92**, 193).—Crude latex, first treated with chemical " fillers " and then vulcanized, is found to give an almost non-corrodible lining for use in pumps treating acid and corrosive liquids, or fluids containing suspended abrasive solids. The lining can easily be attached to gun-metal, cast iron, or other metals, and its exact properties can be modified over a wide range. The material may be applied to the impeller only, or its use can be extended to the cover or the whole interior of the casing.—P. M. C. R.

Rust Preventers and Slushing Materials. E. E. Halls (*Amer. Machinist* (*Eur. Edn.*), 1932, **76**, 491–493).—" Temporary " rust preventers must be selected with a view to: (1) the conditions of storage, service, and exposure; (2) contamination by other surfaces; (3) effect of bi-metallic junctions, and (4) time period. The properties to be considered are : (1) adherence and tenacity; (2) continuity and non-porosity; (3) chemical characteristics; (4) ease of application and removal; (5) type of film, and (6) regularity and cost of supply. Cleaning has to be effected by removal of dirt and grease with solvents or detergents and of oxide, scale, and rust either mechanically or chemically. The manner in which various protectors act and their suitability for rust prevention are discussed. The results of corrosion tests of samples of copper and brass covered by dipping them in various lacquers, varnishes, and oils are tabulated.
—J. H. W.

S-D-O, New Corrosion-Resisting Coating. O. M. Hayden (*Indust. and Eng. Chem.*, 1932, **24**, 563–564).—S-D-O is a synthetic drying oil discovered during

the course of research on synthetic rubber. The only chemicals that attack S-D-O are strong oxidizing agents, such as concentrated hydrogen peroxide, chromic acid, nitric acid, and hot, concentrated sulphuric acid. Hydrofluoric acid penetrates S-D-O films, but does not destroy them. With these exceptions no chemicals have been found against which S-D-O does not give exceptional protection. It is best applied to a metal surface after sand-blasting. Scratch-brushing or pickling is inferior to sand-blasting.—F. J.

VI.—ELECTRODEPOSITION

Discoloration of Cadmium Plate and its Prevention. Gustav Soderberg (*Electrochem. Soc. Preprint*, **1932**, Sept., 315–322).—Cadmium plates from cyanide solutions discolour when stored without air circulation, particularly in warm and humid weather. The discoloration is greatly accelerated when a nitric acid bright dip has been used. The discoloration is probably caused by the action of moist ammonia fumes, formed by the disintegration of cyanide or ammonium salt residues on the surface of the plate. Discoloration can be avoided by means of immersion of the plate in an oxidizing solution prior to the final rinsing and drying. The oxidizing solution should not in itself cause staining of the plate. Known bright dips for cadmium plate are acidic, and dissolve cadmium without gas evolution. The nature of their action appears to be specific. A suitable bright dip which also prevents tarnishing consists of a chromic acid solution containing active acid radicals.—S. G.

Cadmium Plating by the Udylite Process. J. Bary (*Usine*, 1931, **40**, (21), 33).— The main features of the process are the facility of precise control, economical anodes, and the addition to the bath of colloidal starchy bodies.—H. H.

Theory and Practice of Electrolytic Chromium Plating of Metals. V. I. Leiner (*Zvetnye Metally* (*The Non-Ferrous Metals*), 1930, **5**, 1324–1342; *C. Abs.* 1931, **25**, 3920).—[In Russian.] Deposition of chromium by electrolysis of chromium trioxide is not a direct reduction but is the result of a series of successive reactions. The current density must be raised concurrently with temperature. The current efficiency increases with the current density and decreases as the temperature rises. Satisfactory results are obtained with an electrolyte containing chromium trioxide 25, chromic sulphate 0·5, and sulphuric acid 0·3%, the different ingredients being dissolved separately and the solutions then mixed. Up to current densities of 0·5–0·7 amp./cm.^{2} and a temperature of 10° C., the chromium deposit is bright, but the efficiency is low. For the electrolysis of chromium trioxide it is preferable to use lead anodes, and the area should be 0·5–0·67 that of the cathodes. Chromium anodes are difficult to machine and they dissolve much more rapidly than the chromium is deposited at the cathode; moreover, the valency of the chromium dissolved from chromium anodes varies according to the conditions of electrolysis.
—S. G.

Chromium Plating on Zinc. M. de Kay Thompson and F. C. Jelen (*Electrochem. Soc. Preprint*, **1932**, May, 1–8).—Samples of sheet zinc 98·5% pure and of the dimensions 0·046 × 17·8 × 2·5 cm. (0·018 × 7 × 1 in.) were plated with different thicknesses of nickel, then with different thicknesses of chromium, and were tested by immersion in 20% sodium chloride and in 5% sodium sulphate solutions. The time required for the sample to lose its pleasing appearance was considered its life. It was found that the life of a sample prepared in this way is proportional to the thickness of the underlying nickel and independent of the thickness of the chromium up to a thickness corresponding with a 15-minute plate, which is 0·00034 cm. (0·00014 in.). The protection afforded by the underlying nickel depends on the solution from which it is plated. Chromium plated on copper separated from zinc by a thin layer of nickel (to prevent its diffusion into the zinc) does not last so long as when the chromium is plated on nickel of the same thickness as copper. With copper

as an underlying metal the life does depend on the thickness of the chromium deposit because of the difference in colour between chromium and copper. As a preparation of zinc for chromium plating, a composite deposit of nickel and copper is 2 to 3 times as efficient as nickel alone with the same thickness as that of the composite deposit. Intermediate layers of tin and of cadmium followed by chromium did not give good protection, and chromium deposited directly on zinc gave poor protection. Difficulty was found in chromium plating deposits of nickel on zinc unless the nickel plate were heated in boiling water for 30 minutes. This trouble did not occur with die-castings.—S. G.

Working Directions for Rational Chromium Plating. Anon. (*Metallwaren-Ind. u. Galvano-Tech.*, 1932, **30**, 273–276).—Practical hints in the form of questions and answers.—A. R. P.

The Influence of Temperature on the Conductivity of Chromium Baths. Paul Hentschel (*Metallwaren-Ind. u. Galvano-Tech.*, 1932, **30**, 316).—The conductivity of chromium-plating baths is considerably reduced by boiling. The " Kr " bath (see this *J.*, 1932, **50**, 449) remains stable almost indefinitely if not heated above 60° C. and can be operated satisfactorily at 25° C., at which temperature there is a range of 9 amp./dm.^{2} in current density within which bright deposits are obtained.—A. R. P.

High Throwing Power and Bright Plating Limits in the Chromium Bath. Anon. (*Metallwaren-Ind. u. Galvano-Tech.*, 1932, **30**, 375–376).—The " Kr " chromium plating will give bright deposits with current densities as low as 2 amp./dm.^{2} at 25°–45° C. The upper limit for bright deposits rises from 9 amp./dm.^{2} to above 35 amp./dm.^{2} at 35° C. Within the above ranges the throwing power is much higher than that of other chromium baths.—A. R. P.

The Correction of the Sulphate Content of Chromium Baths. E. Raub (*Mitt. Forschungsinst. Edelmetalle*, 1932, **6**, 41–50).—To reduce the sulphate content of chromium-plating baths part of the excess sulphate may be removed by adding barium oxide, hydroxide, or carbonate to the bath. The hydroxide gives a good precipitate of barium sulphate only when the bath is previously heated to 60° C., and should preferably be added as a solution. Solid barium carbonate seems to be the best reagent to use, as 85–95% of the amount added is converted into sulphate, the precipitate is dense and settles well, and the carbon dioxide evolved stirs the solution; for every 1 grm. of sulphuric acid to be removed 2·3–2·4 grm. of barium carbonate are strewn over the surface of the bath, and, after gas evolution ceases, the bath is thoroughly stirred and the barium sulphate allowed to settle for a few hours.—A. R. P.

Sulphate Control in Chromium Plating. R. J. Piersol (*Metal Cleaning and Finishing*, 1932, **4**, 397–400, 414; *C. Abs.*, 1932, **26**, 5262).—A discussion of the necessity for maintaining a close sulphate control in chromium plating and the methods for effecting this.—S. G.

Current Control in Chromium Plating. R. J. Piersol (*Metal Cleaning and Finishing*, 1932, **4**, 277–280; *C. Abs.*, 1932, **26**, 4541).—A discussion of a typical power unit employed in chromium plating and the methods used to control the current.—S. G.

Temperature Control in Chromium Plating. R. J. Piersol (*Metal Cleaning and Finishing*, 1932, **4**, 329–332, 342; *C. Abs.*, 1932, **26**, 4541).—The principles of temperature control and heat transfer and the application of automatic control and recording equipment are discussed.—S. G.

Trivalent-Chromium Control in Chromium Plating. R. J. Piersol (*Metal Cleaning and Finishing*, 1932, **4**, 451–454, 462; *C. Abs.*, 1932, **26**, 5262).—A discussion of the formation and control of trivalent chromium in plating solutions and its effect on the plating range.—S. G.

Iron in the Chromium Bath. Paul Hopper (*Metallwaren-Ind. u. Galvano-Tech.*, 1932, **30**, 377).—Relatively large quantities of iron in the chromium-plating bath have little or no effect on the throwing power or on the character of the deposits.—A. R. P.

Study of Base Metals Used in Industrial Chromium-Plating Applications. Arthur Willink (*Quart. Rev. Amer. Electroplaters' Soc.*, 1932, **19**, (8), 12–15; discussion, 15–19).—The effect of heat and mechanical treatment of the base metal on the adherence of chromium plate is briefly reviewed. The discussion ranges round the difficulties associated with chromium-plating screws and dies.—A. R. P.

New Anodes for Chromium-Plating Baths. Heinr. Rüttermann (*Metall-waren-Ind. u. Galvano-Tech.*, 1932, **30**, 318–319).—Lead anodes require frequent cleaning to remove the passive film of lead chromate which readily forms. To avoid this unpleasant operation, new chromium anodes (exact nature not stated) have recently been prepared which remain active and increase the throwing power of the bath.—A. R. P.

Mist Removal from Chromium-Plating Baths With and Without Exhausters. A. Butziger (*Metallwaren-Ind. u. Galvano-Tech.*, 1931, **29**, 192–195; *C. Abs.*, 1931, **25**, 3921).—The advantages and disadvantages of eliminating " misting " from chromium plating baths by means of exhausters and by means of protecting layers are discussed. Although large exhausters are very efficient, the initial cost and the noise are undesirable. B. prefers protecting layers and suggests an apparatus which spreads the layer on the bath after the articles have been immersed, and sucks the layer back when the articles are to be removed.—S. G.

Chromium Plating Finds Increased Use in Textile Industry. E. R. Granger (*Textile World*, 1930, **77**, 3653; *C. Abs.*, 1930, **24**, 4937).—Chromium is particularly adapted for use in the textile industry because : the coeff. of friction of chromium is 30% lower than that of any other metal; it withstands corrosion; it does not crack or chip like porcelain; it resists oxidation to 1350° F. (732° C.); it is easy to clean, and it is less expensive than many other non-corrosive metals. It is applicable to printing rolls, Schreiner rolls, drying equipment, tensions, guides, and miscellaneous equipment.—S. G.

The Electro-Deposition of Iron–Cobalt Alloys.—I. S. Glasstone and J. C. Speakman (*Trans. Faraday Soc.*, 1932, **28**, 733–740).—The composition of the alloys deposited at current densities up to 7 amp./dm.^{2} from solutions containing various proportions of ferrous and cobalt sulphates has been determined at p_H 3·2, 4·0, and 5·2. The deposition potentials increase with increasing proportion of iron to total metal in the electrolyte from $-0·56$ v. for pure cobalt to $-0·64$ v. for 50% iron and $-0·68$ v. for 100% iron. The proportion of iron in the deposit increases with increasing current density to a maximum which is constant up to high current densities, when a slight decrease occurs. The alloy of maximum iron content obtained from a solution containing a given iron : cobalt ratio is independent of the p_H, and invariably contains a larger iron : cobalt ratio than the solution, but its actual composition is influenced slightly by stirring and by the total metal concentration of the solution. Deposits obtained at very low current density have a lower iron : cobalt ratio than the solution. The theoretical aspects of the deposition of iron–cobalt, iron–nickel, and cobalt–nickel alloys are discussed briefly.—A. R. P.

On the Production of Brass Plating Containing Cadmium. Robert J. Snelling (*Metallwaren-Ind. u. Galvano-Tech.*, 1932, **30**, 395–396).—Zinc–cadmium brass deposits with 60–63% copper, 16–18% zinc, and 20–23% cadmium can be obtained from baths containing 40 grm. of copper cyanide, 35 grm. of zinc cyanide, 3 grm. of cadmium cyanide, and 5 grm. of excess cyanide per litre, using a current density of 0·3 amp./dm.^{2} at 25° C. The nature and composition of the deposits may be varied within wide limits by varying the current density, the bath temperature, and the rate of agitation, and by addition of sodium hydroxide, sodium bisulphite, and a larger proportion of free cyanide. The copper content of the deposits is reduced by increasing the free cyanide (with sufficient excess copper-free deposits may

be obtained), by addition of free alkali, and by addition of bisulphite in excess. Small quantities of bisulphite increase the copper content, whilst free alkali tends to make the deposits coarsely crystalline. Examples are given of the composition of deposits obtained from the bath under various conditions.—A. R. P.

Protection of Steel Against Outdoor Corrosion by Electrodeposits of Nickel, Chromium, or Nickel-Chromium. Pierre Jacquet (*Bull. Soc. Franç. Elect.*, 1932, [v], **2**, 631–656).—Uniform samples of mild steel were cleaned, prepared, and plated under standardized conditions, and examined during and after 9 months' exposure. The coatings, deposited under fully described conditions, included chromium, chromium over nickel, and nickel; supplementary observations were made on nickel-cadmium-chromium, cadmium-nickel-chromium, nickel-copper-chromium, and nickel-cadmium-nickel-chromium coatings. Deposits of nickel less than 0·008 mm. thick afforded little protection; above this thickness the protective effect was good, although a chromium coating over the nickel, and of a thickness varying with that of the undercoat, gave even better results, and was superior from the point of view of appearance. Chromium alone afforded little or no protection up to 0·005 mm. thickness. Nickel-copper-chromium gave the best results as a protective coating; the bad appearance after weathering can be obviated by a light outer coat of chromium. Both nickel-cadmium-chromium and nickel-cadmium-nickel-chromium give good protection, but are liable to scaling of the chromium coat.—P. M. C. R.

Methods for the Pre-Treatment of [Tungsten Steel and] other Difficultly Workable Metals Prior to Coating Them with Corrosion-Resistant Materials [Nickel Plating]. A. Stein (*Korrosion u. Metallschutz*, 1932, **8**, 89–91).—Good nickel plate can be deposited on hardened tungsten-steel only after pickling the metal in an acid solution of ferric chloride and nitrate.—A. R. P.

Importance of the Ferricyanide Test [for Nickel-Plated Steel]. Eugen Werner (*Oberflächentechnik*, 1932, **9**, 31–32).—The value of the test for detecting pores, cracks, and other faults in nickel plating on iron and steel is illustrated.—A. R. P.

Platinum Plating. G. W. Lamotte (*Elect. Rev.*, 1932, **111**, 387).—A process for plating platinum direct on to base metals on a commercial scale has recently been perfected in Great Britain. With an electrolyte containing 3 oz. troy of plating salt per gall. of solution, and using a current density of 7·5 amp./ft.^{2} a plate 0·00003 in. thick is obtained in 6 minutes.—S. V. W.

Electrolytic Rhodium, Platinum, and Palladium Deposits. Paul Haas (*Metallwaren-Ind. u. Galvano-Tech.*, 1932, **30**, 315–316).—A brief review of the properties of rhodium, platinum, and palladium plate.—A. R. P.

Commercial Rhodium Plating. Lionel Cinamon (*Brass World*, 1932, **28**, 97).—Short abstract of a lecture given before the Providence Branch, American Electroplaters' Society, and the American Chemical Society. A comparison of sulphate and phosphate baths, voltages, and methods of control is given. A copper, nickel, or precious metal undercoat is usually necessary.—J. H. W.

Electrodeposition of Tin from Solutions of Sodium Stannate. D. T. Ewing and Alfred Clark (*Univ. Mich. Eng. Exper. Sta. Bull.* No. **43**, 1932, 1–16; *C. Abs.*, 1932, **26**, 3442).—A temperature of 60° C. and a concentration of 140 grm./litre gave the highest current efficiency and a good deposit. The addition of sodium hydroxide lowered the current efficiency but produced a more dense deposit.—S. G.

The Electrodeposition of Tin. Possibilities of the Sulphocresylic Acid Bath. Anon. (*Chem. Trade J.*, 1932, **91**, 397).—The bath is prepared by the anodic dissolution of tin in a solution containing 1 lb./gall. of sulphocresylic acid using a current of 40–50 amp./ft.^{2} at 2 v. and an iron cathode. The anodes should be bagged or separated from the cathode by a porous diaphragm. For

plating the bath is operated at room temperature using tin anodes and a current density of 15–20 amp./ft.^{2}. The cathode current efficiency is 100%. Bright deposits are obtained directly; any deterioration in the nature of the deposit indicates depletion of soluble tin owing to too rapid deposition or too small an anode area. The bath should be replenished, to allow for drag-out, with a stock solution made as above and kept in reserve. To determine the thickness of the deposit a weighed quantity of the metal is stripped in a 10–20% solution of sodium plumbite (for iron) or in a mixture of 63% sulphuric acid, 12% nitric acid, and 25% water at 75° C. (for brass and copper).
—A. R. P.

The Electrodeposition of Alloys. Lawrence E. Stout (*Washington Univ. Studies Sci. Tech.*, No. **6**, [N. S.], 1932, 9–37; *C. Abs.*, 1932, **26**, 5263).—A general review is given and previous work on zinc–cadmium, silver–cadmium, copper–nickel, iron–nickel, and copper–nickel–iron alloys is discussed. The conditions for the plating of the copper–iron system are given in detail. It is concluded that: (1) the composition of the deposits depends on the bath composition; (2) the percentage of iron in the deposit is independent of the current density, temperature, and tartrate content of the bath; (3) the presence of free cyanide in the bath prevents the deposition of iron; and (4) copper–iron alloys of good physical form may be obtained from the cyanide bath in the presence of potassium tartrate.—S. G.

The Adhesion of Metallic Electrodeposits. M. de Kay Thompson (*Metal Cleaning and Finishing*, 1932, **4**, 385–388; *C. Abs.*, 1932, **26**, 5262).—A discussion of the forces which make electrodeposits adhere to the base metal and also of the inherent causes for the lack of such adhesion.—S. G.

The Galvanic Treatment of Aluminium. J. Fischer (*Metallwirtschaft*, 1932, **11**, 473–474).—After reviewing various methods of producing protective metallic films on aluminium, a recent process developed by Siemens and Halske is described. The aluminium is oxidized in a chromic acid bath with direct current or in a soda bath with alternating current, then reduced in an alkaline bath containing a suitable metal, which is deposited on the aluminium in a thin film, on which a thin nickel film is applied. Finally the metal is plated with copper, chromium, or cadmium in the usual way.—v. G.

The Life of Plated Zinc as Affected by the Thickness of the Coating. E. A. Anderson (*Quart. Rev. Amer. Electroplaters' Soc.*, 1932, **19**, (8), 19–26; discussion, 26–31).—A thickness of 0·0003 in. of nickel and 0·00002 in. of chromium has been found sufficient to protect zinc from atmospheric corrosion for more than 2 years. Thinner nickel coats fail more rapidly.—A. R. P.

Plating of Zinc-Base Die-Castings. R. J. Wirshing (*Quart. Rev. Amer. Electroplaters' Soc.*, 1932, **19**, (8), 9–12).—For long life at least 0·001 in. of plating is necessary; this should consist preferably of 0·0005 in. of copper followed by the same thickness of nickel and a flash chromium plate.—A. R. P.

Preparation of Seamless Metal Tubes by Electrical Methods. Anon. (*Oberflächentechnik*, 1932, **9**, 1–2).—The cathode consists of a rotating mandrel of Thermisilid or chromium steel covered at the top end with a thin tube of the metal to be deposited. As the electrolysis proceeds, this tube is drawn slowly off the mandrel, so that a continuous tube of metal is gradually formed. Fusible metal cathodes can also be used and the metal then melted out. The process is described in detail with references to illustrations of the necessary apparatus. Very pure copper, zinc, and iron tubes are readily obtained, but the rate of manufacture is slow.—A. R. P.

Electro-Plating Rheostats. Frank Peasgood (*Met. Ind. (Lond.)*, 1932, **41**, 327–329).—Describes 3 types of rheostat for electroplating work with currents up to 300 amp. The frequently rapid deterioration of these resistances is usually due to the operation of the plant and not to the design of the apparatus.
—J. H. W.

VII.—ELECTROMETALLURGY AND ELECTROCHEMISTRY

(Other than Electrodeposition and Electro-refining.)

Potential Gradients in Anodic Films. Frank W. Godsey, Jr. (*Electrochem. Soc. Preprint*, 1932, Sept., 347–357).—The gas-oxide, solid oxide, and adsorbed liquid theories of the operation of electrolytic condensers using aluminium and tantalum electrodes are critically discussed.—A. R. P.

The Transport Number of Gold in Gold Amalgam. Karl Schwarz (*Z. physikal. Chem.*, 1932, [A], **161**, 231–232).—In the electrolysis of gold amalgam the gold migrates to the cathode. The transport number at 25° C. is $2 \cdot 78 \times 10^{-7}$.—B. Bl.

The Influence of High-Frequency Currents on Polarized Electrodes.—I. S. Glasstone and J. D. Reynolds (*Trans. Faraday Soc.*, 1932, **28**, 582–596).—Superimposed high-frequency currents decrease the polarization of a platinum or lead cathode to an extent which is approximately proportional to the current density of the high-frequency current. This effect is small at high polarizing current density, almost independent of the dissolved gas in the electrolyte, and at constant frequency, proportional to the e.m.f. of the high-frequency current; on the other hand, the effect is large at low polarizing current density in solutions saturated with air or oxygen. These and other effects of superimposed high-frequency currents are attributed to an increase in the rate of diffusion of depolarizing agents to the electrode brought about by the high-frequency current.—A. R. P.

The Time Factor in Anodic Passivation of Metals. Remarks on the Paper of W. J. Shutt and V. J. Stirrup. W. J. Müller (*Trans. Faraday Soc.*, 1932, **28**, 471–473).—The results of S. and S. (see this *J.*, 1931, **47**, 165, and 1932, **50**, 252) are shown to be in accord with M.'s surface layer theory of passivation. —A. R. P.

Note on the Theory of the Hydrogen Overvoltage. A. Frumkin (*Z. physikal. Chem.*, 1932, [A], **160**, 116–118).—The logarithmic law connecting hydrogen over-voltage with current density and the relations between the catalytic activity and the affinity constants of weak acids and bases depend on the same basic principles.—B. Bl.

Chrom–Selenium Photovoltaic Cells. Colin G. Fink and Dwight K. Alpern (*Electrochem. Soc. Preprint*, 1932, Sept., 305–313).—Electrodeposited films of a chromium–selenium combination have been obtained (details not given) which have a sensitivity of 150 microamp. per lumen. Photovoltaic cells made with this film appear to conform to the requirements of a true photoelectric effect in that the current is directly proportional to the absorbed illumination and the response is without detectable lag even with rapid variations of light. The maximum response of the cell is at 5100 A.—A. R. P.

VIII.—REFINING

(Including Electro-refining.)

On the Refining of Nickel. E. T. Richards (*Metallbörse*, 1932, **22**, 673–674).—Most deleterious impurities are removed by melting the metal in the air; sulphur and oxygen are then removed by covering the molten metal with a calcium silicate slag and adding wood charcoal or manganese followed by magnesium.—A. R. P.

Remelting of Nickel for the Production of Compact Pure Nickel Plates for Anodes. Leo Schmal (*Z. ges. Giesserei-Praxis*: *Das Metall*, 1931, **52**, 61–64; *Chem. Zentr.*, 1931, **102**, II, 304; *C. Abs.*, 1932, **26**, 4280).—Crude nickel in

cubes, bars, or granular form is furnished by the smelter 98-99% pure, the particularly injurious impurities being iron, arsenic, sulphur, and carbon. Because of its high melting point, nickel readily forms the oxide which dissolves in the metal with the inclusion of gases. As a deoxidizer 0·05% magnesium, magnesium–aluminium alloy or magnesium–nickel alloy is used; magnesium–manganese–phosphorus alloy in the proportion 5 : 3 : 2 is very good; phosphorus alone in slight excess makes the nickel brittle. During remelting, the surface of the bath must be protected, by a glass cover, from oxidation and gas absorption. Nickel readily absorbs carbon from the melting pots, with the formation of fine pores which render the metal useless. The melting pots or crucibles must, therefore, have linings rich in clay. Casting moulds are best made of hematite pig iron, covered inside with graphite and linseed oil. Fine-pored crucibles lined with chamotte are placed in the founding moulds. Shaft crucible furnaces are used, oil furnaces are not suitable, and electric furnaces are too expensive to operate.—S. G.

Refining Platinum Metals.—I.—II. Martin Schwitter (*Brass World*, 1932, **28**, 179–180, 205–206).—Reprinted from *Metal and Mineral Markets*. (I) The process of extracting platinum as an ammonium chloroplatinate precipitate from the products of cupellation is briefly described. This precipitate is further refined either by: (1) the sulphur dioxide method, in which it is reduced with sulphur dioxide and oxidized with sodium chlorate, the resulting sponge containing more than 99% platinum; or (2) the oxalic acid method, which is used when iridium or palladium is present, and in which impure metallic platinum is first obtained as above, dissolved in aqua regia, oxalic acid added to the hot nitric acid-free solution, and the platinum precipitated with ammonium chloride. (II) To refine palladium, the metal is dissolved in aqua regia, the nitric acid removed with hydrochloric acid and ammonium chloride added. After filtration, more hydrochloric acid and ammonium chloride are added and the palladium is precipitated as ammonium chloropalladate with sodium chlorate. The separation of iridium, ruthenium, rhodium, and osmium from metal containing gold, platinum, palladium, and large quantities of silver is briefly described, and the treatment of wash waters from these various processes is outlined.—J. H. W.

Modern Tin Refining. Walter Savelsberg (*Metallbörse*, 1932, **22**, 833–834, 865, 897–898).—Recent improvements in methods of tin refining include treatment of the liquated metal with aluminium (added as a tin–aluminium alloy) to remove the last of the copper, antimony, and arsenic. Excess of aluminium is removed by blowing air and steam through the metal at 250–260° C. About 0·1% aluminium is required for every 1% of impurity to be removed, but not more than 3% should be added. Difficulties are encountered in treating the dross owing to the ease with which it reacts with water with the evolution of arsine. Lead is not removed by this process, but the greater part may be separated by cooling the metal to 232° C., and, as soon as the tin has crystallized and the temperature shows a tendency to drop, applying suction to withdraw the still liquid tin–lead eutectic. The remainder of the lead is removed by treating the purified metal with stannous chloride at 250–260° C. and removing the crust. The hardhead obtained in the original liquation is heated with high-grade ferro-silicon which removes the iron and allows the remaining tin to be liquated out.—A. R. P.

ELECTROLYTIC METHODS

The New Refinery at Copper Cliff, Ontario. V. A. James (*Canad. Min. Met. Bull.*, 1932, (**244**), 335–352).—A detailed description of new plant for the electrolytic refining of copper and silver.—E. S. H.

The Electrolytic Copper Refining Plant of the Zinnwerke Wilhelmsburg G.m.b.H., at Harburg-Wilhelmsburg near Hamburg. G. Eger (*Siemens Rev.*, 1932, **8**, (3), 49–55).—[In English.] Following a *résumé* of the electrolytic copper refining process, a description is given of the plant at the Wilhelmsburg tin works, near Hamburg, erected in 1929–30. The daily output is 50 tons, and the unit is the largest of its kind installed at the present time by the German electrolytic copper-refining industry.—R. Gr.

Contribution to Our Knowledge of the Principles for the Technical Electrolysis of Zinc with Reference to the Current Relations and the Composition of the Electrolyte. P. Röntgen and H. Högel (*Abhandl. Inst. Metallhütt. u. Elektromet. Tech. Hochschule, Aachen*, 1932, [N.F.], **1**, 16 pp.).—In the production of electrolytic zinc from zinc sulphate solutions derived from the leaching of ores the voltage of the baths decreases with increasing acidity up to 20%; with up to 6–7% of free acid increase in the zinc content of the electrolyte reduces the resistance, but at higher acidities increasing zinc content increases the resistance. The current yield falls with rise in free acidity to an extent which is greater the lower the zinc content. In neutral solutions the deposits are needle-like and nodular, as well as dark and shiny in parts; with increasing acidity up to 20% the deposits become smoother and more crystalline. In 40% acid re-dissolution of the cathode deposit is rapid. Most of the troubles encountered in the electrolysis are attributed to the formation of lead sulphate and peroxide at the insoluble lead anodes. The lowest power consumption is obtained with 13–20% of free acid according to the current density used.
—A. R. P.

Investigations on the Influence of Current Density and Temperature on the Technical Electrolysis of Zinc. P. Röntgen (*Abhandl. Inst. Metallhütt. u. Elektromet. Tech. Hochschule, Aachen*, 1932, [N.F.], **1**, 8 pp.).—The factors which influence the hydrogen overvoltage, especially the current density and composition of the solution, are discussed with reference to their action in modern methods of producing electrolytic zinc directly from its ores. High temperatures and high current densities give better deposits with lower current costs, especially when the electrolyte contains small quantities of impurities. Colloids reduce the current yield to a larger extent at low temperatures than at high. Cobalt has a particularly pernicious effect on the current yields at low temperatures, but its action is much less marked in hot solutions. Taking all things into consideration, the most economical procedure appears to be the use of current densities of about 6000 amp./m.^{2} and a bath temperature of 60°–80° C.—A. R. P.

On the Effect of Colloids on Technical Zinc Electrolysis. P. Röntgen and F. Felchner (*Arch. Erzbergbau, Erzaufbereitung, Metallhüttenw.*, 1932, **2**, 26–48; and *Abhandl. Inst. Metallhütt. u. Elektromet. Tech. Hochschule, Aachen*, 1932, [N.F.], **1**, 23 pp.).—The effect of additions of gelatin and glue on the deposition of zinc from pure sulphate solutions under varying conditions of current density, acidity, and bath temperature has been investigated. In all cases addition of colloid reduced the current yield, especially at concentrations of 0·05–0·5 grm./l. Increasing current density counteracts the effect of colloids, but increasing acidity considerably enhances the effect. The bath voltage increases with increasing colloid, but by thermal decomposition of the colloid the voltage again falls and the current yield rises, especially at low p_H. Maximum current yield of zinc is obtained after the colloid has aged in the bath for 48 hrs. With rising temperature the yields are greatest at low acidity, but are decreased by addition of colloid. A theoretical explanation of the action of colloids is given.—A. R. P.

The Utilization of Secondary Reactions in Igneous Electrolysis. L. Andrieux (*Chim. et Ind.*, 1931, **25**, 1047–1057).—A historical survey of electrolysis in fused baths is first given and the influence of secondary reactions in

the following processes is then reviewed—refining of aluminium, preparation of magnesium, preparation of boron, tungsten, and molybdenum.—W. A. C. N.

IX.—ANALYSIS

Tentative Methods of Chemical Analysis of Aluminium and Light Aluminium Alloys (B 40–28 T). —— (*Amer. Soc. Test. Mat. Tentative Standards*, 1932, 309–324).—See this *J.*, 1928, **40**, 585.—S. G.

Tentative Methods of Chemical Analysis of Metallic Materials for Electrical Heating (B 71–29 T). —— (*Amer. Soc. Test. Mat. Tentative Standards*, 1932, 255–273).—This tentative standard (cf. this *J.*, 1928, **40**, 587) is now published in a revised form.—S. G.

Tentative Methods of Chemical Analysis of Silver Solders (B 81–31 T). —— (*Amer. Soc. Test. Mat. Tentative Standards*, 1932, 325–334).—See this *J.*, 1931, **47**, 487).—S. G.

On the Detection of Cæsium, Rubidium, and Thallium by Spot Tests. N. A. Tananaev (*Z. anal. Chem.*, 1932, **88**, 343–347).—*Detection of Cs :* One drop of KI solution is placed on a piece of filter-paper, then 1 drop of $SnCl_2$ and 1 drop of the solution to be tested, followed by a further drop of KI; the spot begins to darken owing to the formation of $CsSnI_5$. Tl should first be removed as TlI. *Detection of Rb :* Tl and Cs are first removed by precipitation with $KBiI_4$, the filtrate is evaporated to dryness, the residue ignited with $H_2C_2O_4$, the Rb extracted with H_2O, and the filtered solution again evaporated with HCl to dryness; this residue is moistened with a few drops of a mixed solution of $PdCl_2$ and $AuCl_3$, which precipitates Rb as bluish-black $Rb_2AuPdCl_7$. *Detection of Tl :* The solution is heated on a filter-paper impregnated with a HCl solution of $PdCl_2$ and $AuCl_3$; in the presence of Tl a cinnamon-brown colour appears which turns black with NaOH owing to reduction of the Au and Pd by TlOH.—A. R. P.

The Solubility of Antimony Trisulphide and Stannic Sulphide in Ammonia and Ammonium Carbonate. P. A. Epik (*Z. anal. Chem.*, 1932, **89**, 17–23).— Sb_2S_3 is soluble up to a maximum of 1·28 grm./100 c.c. of aqueous NH_3, but practically insoluble in $(NH_4)_2CO_3$ solution. SnS_2 is readily soluble in aqueous NH_3; its solubility in $(NH_4)_2CO_3$ solutions reaches a maximum of 0·17 grm./ 100 c.c. In view of these facts, the use of $(NH_4)_2CO_3$ solutions to separate As from Sn and Sb cannot be recommended.—A. R. P.

Separation of Cadmium from Zinc by H_2S. Leo Baumeister (*Chemist-Analyst*, 1932, **21**, (3), 7–8).—Separation is best effected in H_2SO_4 solution rather than in HCl. For the separation of little Cd from much Zn the solution should contain 4 c.c. of H_2SO_4 (*d* 1·84) per 100 c.c.; double precipitation is generally advisable. Determination of Cd by electrolysis is more convenient than weighing as $CdSO_4$ or $Cd_2P_2O_7$. For 1–10 mg. of Cd electrolysis is carried out in a feebly alkaline cyanide solution, but for more than 10 mg. of Cd a slightly acid sulphate solution is better. Cu-plated Pt cathodes are used; after weighing the deposit it can be removed without appreciably affecting the Cu by treatment with 2% HNO_3.—A. R. P.

Materials in the Analysis of Platinum Metals. IV.—On the Analytical Separation of Copper from Rhodium. O. E. Zviagintzev (*Zhurnal Prikladnoï Khimii (Journal of Applied Chemistry)*, 1932, [B], **5**, (2), 217–218).—[In Russian, with German summary.] Alloys of Cu with Rh, especially if the Rh exceeds 50%, are very sparingly soluble in acids, even aqua regia. If the alloy is fused for some time, however, with 10 times its weight of Zn, it dissolves completely in aqua regia. When the alloy contains more than 50% Rh, this metal is precipitated with NH_4NO_2 in excess of NH_4Cl. The precipitate

(which contains some Cu) is redissolved, reprecipitated, heated to redness in a stream of H_2, and weighed as Rh. If the alloy contains less than 50% Rh, the Cu is first removed as CuCNS, and the Rh determined as above.

—M. Z.

Studies on the Oxime Method for the Gravimetric Determination of Various Metals by Means of the Thermo-Balance. Saburo Ishimaru (*Kinzoku no Kenkyu*, 1932, **9**, (9), 378–391).—[In Japanese.] The oxime method for the gravimetric determination of Cu, Mg, Zn, Cd, Al, Bi, Fe, Mn, Ni, Co, Ti, U, Th, Ca and Pb was studied by means of the thermo-balance. The results of the experiments are shown in a table.—S. G.

The Potentiometric Determination of Aluminium. W. Stefanovsky (*Zhurnal Prikladnoi Khimii* (*Journal of Applied Chemistry*), 1932, [B], **5**, (1), 92–98).—[In Russian, with German summary.] Accurate results cannot be obtained by the potentiometric titration of $Al(NO_3)_3$ with NaOH unless $NaNO_3$ is present; this reduces the error from 4·4–6·5% to 0·5–1·3%, but owing to the small change in potential the determination of the equivalent point is very difficult. Titration with HNO_3 of the excess NaOH added during the titration of the $Al(NO_3)_3$ gave a marked increase in accuracy. The potentiometric titration of $AlCl_3$ with NaOH gave no positive results : the errors were 8·3–8·6% and the degree of hydrolysis of the salt was greater.

—M. Z.

The Determination of Minute Amounts of Copper in the Presence of Iron and Certain Other Metals. L. Haddock and Norman Evers (*Analyst*, 1932, **57**, 495–499).—The solution is treated with citric acid, then with a slight excess of NH_4OH and a little Na diethyldithiocarbamate. The Cu compound is extracted by shaking with CCl_4 and the yellow constituent of the coloured solution is measured in a Lovibond tintometer.—A. R. P.

On the Disturbing Effect of Chlorine and Ammonium Salts in the Colorimetric Determination of Small Quantities of Mercury with Diphenylcarbazone. Vladimir Majer (*Z. anal. Chem.*, 1932, **87**, 352–356).—NH_4 salts and Cl interfere with the colorimetric determination of Hg. Cl is removed by evaporation over P_2O_5 and soda–lime in a vacuum desiccator, and NH_4 salts by precipitation of the Hg on Cu wire. The Hg is removed from the Cu by dissolution in Cl water and after removal of the excess Cl the Hg is determined colorimetrically with diphenylcarbazone.—A. R. P.

On the Preparation of Sodium Cobaltinitrite as a Reagent for Potassium. E. Rupp and A. Poggendorf (*Apoth.-Zeit.*, 1932, **47**, 282–283; *Chem. Zentr.*, 1932, **103**, I., 3205–3206).—A solution of 5 grm. of $Co(NO_3)_2$ crystals in 2·1 grm. of glacial $CH_3 \cdot COOH$ and 1 c.c. of H_2O is treated with a lukewarm solution of 10 grm. of $NaNO_2$ in 11 c.c. of H_2O, air is drawn through the mixture for 30 minutes to remove NO, and, after filtering, the solution is mixed with 20 grm. of anhydrous Na_2SO_4 and the mixture dried in a vacuum desiccator. The pulverized mass may be kept unchanged for 2 years in a brown glass bottle.

—A. R. P.

Determination of Silicon in Aluminium. L. H. Callendar (*Analyst*, 1932, **57**, 500–511).—Four methods are described and discussed. In all cases double evaporation is necessary to recover all the SiO_2 and the residue from HF treatment should be ignited to 1000° C. to ensure elimination of SO_3. There is no satisfactory method of determining Si and SiO_2 separately in Al.

—A. R. P.

Microelectrolytic Determination of Silver, Mercury and Cadmium in Ammoniacal Solutions. A. Okáč (*Z. anal. Chem.*, 1932, **89**, 106–112).—The method previously described for Cu, Ni, and Co (see this *J.*, 1932, **50**, 442, 443) may be applied to the determination of Ag, Hg, and Cd.—A. R. P.

The Potentiometric Estimation of Zinc. I. Tananaev (*Zhurnal Prikladnoi Khimii* (*Journal of Applied Chemistry*), 1932, [B], **5**, (1), 86–91).—[In Rus-

sian, with German summary.] Existing volumetric methods for Zn are briefly summarized and the method involving precipitation of the Zn with an excess of $K_4Fe(CN)_6$ followed by potentiometric back-titration of this excess with $KMnO_4$ has been investigated. Direct potentiometric titration of Zn with $K_4Fe(CN)_6$ in the presence of $K_3Fe(CN)_6$ is unsuitable for routine analysis owing to the slow rate of attainment of the equilibrium potential and the low accuracy (0·5–1%). If, on the other, the excess of $K_4Fe(CN)_6$ is titrated with $KMnO_4$ in the presence of $KHSO_4$ after the Zn has been precipitated from a boiling solution, the change in potential changes sharply at the end point and the accuracy is 0·1–0·15%.—M. Z.

X.—LABORATORY APPARATUS, INSTRUMENTS, &c.

(See also "Testing" and "Pyrometry.")

Modifications in the Haughton–Hanson Thermostat. J. L. Haughton (*J. Sci. Instruments*, 1932, **9**, 310–315).—A description of different modifications and developments of the original Haughton–Hanson thermostat (this *J.*, 1915, **14**, 145) with special reference to : the design of (1) the U-tube; (2) the cold bulb; and to (3) devices for slow heating and cooling; (4) controlling resistances, ammeter, and general lay-out. Several of these devices have been described previously, but the paper gives a most valuable review, and discusses critically the most suitable modifications for different purposes.
—W. H.-R.

Recent Workshop Practice, with Special Reference to Optico-Mechanical Instruments for Exact Measurement. O. P. van Steewen (*Werkzeug* (Suppt. to *Maschinenkonstrukteur*), 1931, **7**, 177–180, 193–197).—The following instruments are described and illustrated : (1) Hirth Minimeter, with adaptations for taking exact internal measurements of spherical sections and of channels, or for automatically indicating internal measurements on a scale; (2) Zeiss Passameter, for the external measurement of diameter, sphericity, conicity, &c., and also for certain types of internal measurements; (3) Zeiss Passimeter, a companion instrument to the Passameter, for internal measurements; (4) vertical and horizontal forms of Zeiss Optimeter, and an adaptation of this instrument to internal measurement; (5) Werner Microlux Gauge; (6) Zeiss Ultra-Optimeter for especially accurate work; (7) optical gauges for screw-threads and for testing accuracy of pitch; (8) gear-testing apparatus; (9) a conveniently adjustable type of bench microscope for metallographic examination; (10) an optical profile-checking machine.—P. M. C. R.

Technique of Vibration Measurements. E. Lehr (*Z.V.d.I.*, 1932, **76**, 1065–1073).—A review of modern measuring instruments and bibliography.—v. G.

New Automatic Temperature Control. Anon. (*Fuel Economist*, 1932, **8**, (85), 59–60).—A mercury-in-steel thermometer and valve operated by compressed air designed for thermostatic control between 40° and 1200° F. (4° and 649° C.) are described.—J. S. G. T.

On the Permeability of Refractory Masses to Gas. F. Durau (*Z. tech. Physik*, 1932, **13**, 228–233).—Tests have been made at various temperatures on the amount of gas evolved by, and the permeability to gases of, tubes made of various refractories as used in the laboratory. All tubes were gas-tight up to 1200° C., but evolved considerable quantities of dissolved, occluded, or chemically produced (by reactions of the constituents) gases, the composition of which varied considerably.—J. W.

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

The Testing of Large Castings. Anon. (*Shipbuilder*, 1932, **39**, 522).—A discussion on the testing of large castings deals with the values obtained from test-pieces attached to the casting and test-pieces cast separately, and also with special percussive or hammering tests for soundness, and suggests that such testing cannot reveal the condition of the casting as a whole, and that reliance must be placed on good foundry practice. Reference is also made to the use of the gamma rays for such testing.—J. W. D.

The Elongation Lines Method for the Determination of the Stress Distribution Governing the Safety Factor in Alternating Fatigue Tests. Otto Dietrich and Ernst Lehr (*Z.V.d.I.*, 1932, **76**, 973–982).—To determine the distribution of the elastic stresses in a metal the specimen is coated with a varnish (nature not stated) having suitable mechanical properties, and then loaded as used in practice. With loads well below the elastic limit, fissures perpendicular to the direction of maximum tensile stress appear in the varnish film. From the course of these fissures and from elongation measurements with a mirror apparatus the magnitude and distribution of the stresses can be determined.—v. G.

On the Method of Testing Metals in Statical Tension. W. Alexandrov and B. Pantchenko (*Vestnick standartizazii* (*Messenger of Standardization*), 1931, 11–12 (35–36), 31–38).—[In Russian.] The following points must be considered in agreeing on a standard method of testing: (1) a definition of the test itself and of the characteristic features of the testing process; (2) rules for preparing the specimens; (3) shape and size of the specimens; (4) rules for testing technique; (5) evaluation of the results. The above points are examined and in their light are compared the standards adopted by various institutions and works.—N. A.

Tentative Methods of Compression Testing of Metallic Materials (E 9–27 T) —— (*Amer. Soc. Test. Mat. Tentative Standards*, 1932, 1093–1097).—See this *J.*, 1927, 38, 529.—S. G.

On the Theory of Herbert's Pendulum [Hardness Tester]. E. M. Gutair (*Vestnick Ingenerov i Tehnikov* (*Messenger of Engineers and Technologists*), 1932, (5), 234–238).—[In Russian.] The time taken for a single oscillation of the Herbert pendulum is given by the expression, $T = \pi \left(\dfrac{Sc^2 + (r + e)^2}{g\left(\dfrac{r^2}{R - r}\right) + e} \right)^{\frac{1}{2}}$, where

r is the radius of the ball, R the radius of the impression, e the distance between the centre of gravity of the pendulum and the centre of the ball, and Sc the radius of inertia. Errors in the conclusions of Pomp and Schweinitz (*Mitt. K.-W. Inst. Eisenforschung*, 1926, **8**, 79) are discussed.—N. A.

Testing Sheet Metals by Cupping. J. Cournot (*Usine*, 1931, **40**, (21), 39).— Abstract of a paper read before the Société Française pour l'Essais des Matériaux. Describes the test developed by Siebel and Pomp in which an initial hole is made in the test-piece before cupping. See this *J.*, 1930, 43, 579; 44, 600; 1931, 47, 392.—H. W. G. H.

Tentative Accelerated Life Test for Metallic Materials for Electrical Heating (B 76–29 T). —— (*Amer. Soc. Test. Mat. Tentative Standards*, 1932, 280–288).—See this *J.*, 1929, 42, 560.—S. G.

Tentative Methods of Test for Determining the Temperature–Resistance Constants of Resistance Alloys (B 84–31 T). —— (*Amer. Soc. Test. Mat. Tentative Standards*, 1932, 274–279).—See this *J.*, 1932, 50, 91–92.—S. G.

Tentative Method of Test for Thermoelectric Power (B 77–30). —— (*Amer. Soc. Test. Mat. Tentative Standards*, 1932, 289–291).—See this *J.*, 1930, **44**, 606.—S. G.

Tentative Definitions of Terms, with Units and Symbols, Relating to Magnetic Testing (A 127–31 T). —— (*Amer. Soc. Test. Mat. Tentative Standards*, 1932, 219–222).—See this *J.*, 1931, **47**, 662.—S. G.

Tentative Specifications for Round-Hole Screens for Testing Purposes (E 17–31 T). —— (*Amer. Soc. Test. Mat. Tentative Standards*, 1932, 1075–1076).—See this *J.*, 1932, **50**, 93.—S. G.

Tentative Definition of the Term Screen (Sieve) (E 13–28 T). —— (*Amer. Soc. Test. Mat. Tentative Standards*, 1932, 1114).—See this *J.*, 1928, **40**, 620. —S. G.

RADIOLOGY

Experimental Radiography Utilizing the Gamma Rays of Radium. C. G. Osment (*Brit. J. Radiology*, 1932, **5**, 269–274).—Without going into details of the underlying principles, the possibilities and advantages of using gamma rays instead of X-rays for the examination of metals are pointed out. The quantity of radium required for radiographic purposes depends on : (1) thickness of material to be radiographed; (2) number of objects to be radiographed; (3) maximum time that could be allowed for the exposure. Tables showing the connection between the thickness of steel penetrated and the amount of radium required, are given. Owing to their greater penetrating power, gamma rays will probably prove the only satisfactory method of testing castings having a thickness of more than 3 in. of steel or its equivalent. A number of radiographs obtained with gamma rays are shown and described.—S. V. W.

Radiographic Examination of Metals by Means of Gamma Rays and Radioactive Bodies. M. Holweck (*Bull. Soc. Ingénieurs Soudeurs*, 1932, **3**, 583–590).—The use of radium, mesothorium, or radon eliminates the complicated and bulky apparatus necessary for the production of X-rays. Examination of large objects *in situ* is therefore much easier. Exposures necessary are of the order of 15 hrs. and the quantity of radium necessary to examine thick material increases rapidly with the thickness. A table of quantities necessary for various thicknesses is given. It is possible, by means of gamma rays, to detect a fault representing 2% of the thickness of the material if the fault is near the photographic film, or 4%, if it is near the source of rays.—H. W. G. H.

Technical X-Ray Pictures [of Welds] and their Interpretation. W. Grimm and F. Wulff (*Autogene Metallbearbeitung*, 1932, **25**, 217–221 and 232–237). —The two methods of X-ray examination—visual and photographic—are explained; the former has limited application, but gives immediate information, whilst the latter has wider scope, but requires time for development of the film. The correct interpretation of X-ray photographs is not a simple matter, as there are many factors which may be misleading. These are explained. A radiograph of a weld is illustrated, showing the presence of entrapped gas and stress cracks due to shrinkage. Deductions regarding the position of the faults and their nature are explained. The effect of exposure time on the radiograph is illustrated by photographs of a boiler weld. The exposure is affected by voltage changes, differences in X-ray tubes, and the constitution of the material. The effects of space between film and specimen, undue pressure on the film, faulty developing, and faulty cassettes are also illustrated and explained. Examples are shown of radiographed acetylene and arc welds in steel, welds in copper, brass, aluminium, steel castings, bronze billets, and gas cylinders.—H. W. G. H.

XII.—PYROMETRY

The Use of Optical Pyrometers in Foundries. M. Held (*Fonderie moderne*, 1932, 26, 390–392).—A description of the principles, construction, and methods of using total and partial radiation and disappearing filament pyrometers in the foundry for measuring temperatures above 1600° C. and a discussion of the conditions which dictate the type to be used, are given.—J. H. W.

On the Calibration of Thermocouples at High Temperatures. Keizô Iwasè (*Kinzoku no Kenkyu*, 1932, 9, (8), 321–327).—[In Japanese.] The danger of supercooling tends to vitiate the cooling-curve method in the case of such standard silicates as lithium silicate or diopside, and the disadvantages of the alternative (quenching) method make the use of silicates infrequent. I. describes a method for the accurate determination by cooling curves for the above and other silicates. For the determination of the fixed points between 1000° and 1600° C., titanite (m.p. 1382° C.) and the nickel–carbon eutectic (m.p. 1324° C.) are recommended.—P. M. C. R.

An Improved Comparison Source for Measuring Furnace Temperatures. E. M. Watson and W. P. Zabel (*Gen. Elect. Rev.*, 1932, 35, 120–121).—The brightness of a stout carbon filament in an incandescent lamp is compared directly against the brightness of the furnace. To reduce glare from the lamp the inside of the bulb is blackened with the exception of two eye-holes in line with the filament. Auxiliary equipment consists of a suitable transformer or resistance for reducing the voltage to that necessary for the lamp and a second regulating resistance for making the actual comparison. The filament current is taken, and this may be referred to a temperature scale.—S. V. W.

XIII.—FOUNDRY PRACTICE AND APPLIANCES

Materials for the Scientific Designing of Casting Heads. W. I. Fundator (*Niimash Izvestia Nauchno-issledovatelskogo Instituta Mashinostroenia i Metalloobrabotki (Bulletin of the Scientific Research Institute of Machine Building and Metal Treatment)*, 1932, (5–6), 289–318).—[In Russian.] Experimental data for the throughput capacity of straight and casting heads are given. A table shows the minimum rate of feed, *i.e.* the minimum cross-section of the heads at which the mould is filled completely without giving rise to rejects owing to cavities. Examples of calculations for casting heads in accordance with F.'s tables are given.—N. A.

Shrinkage and Gas Cavities. E. Scheuer (*Metallurgist* (Suppt. to *Engineer*), 1932, 8, 15–16).—A summary and discussion of a paper by S. in *Metallwirtschaft*, 1931, 10, 947–951. The writer of the summary criticises the views of S. as to the effects of gas or shrinkage cavities in metal objects, suggesting that the weakening effect is much greater than might be anticipated.—R. G.

The New RWR Casting Process of the Vereinigte Aluminium-Werke A.-G. —— Kessner (*Metallwirtschaft*, 1932, 11, 583–584; and (translation) *Light Metals Research*, 1932, 2, (18), 2–5).—The aluminium is cast into a copper mould previously heated to the melting point of aluminium, so that the metal remains liquid until the mould is filled. The mould is then covered with a copper lid and inverted, and water is sprayed on this lid, so that the metal solidifies from the bottom upwards. To obtain a fine-grained structure the mould is vibrated at a suitable frequency and amplitude. The casting temperature is 720° C., casting time for a 50-kg. ingot 120–135 seconds, time to invert the ingot 16–18 seconds, time of shaking 10 minutes, total casting time 22–25 minutes. The castings are dense, free from gases and vapours, and have no shrinkage pipe.—v. G.

The Casting of Ingots. Anon. (*Metallurgist* (Suppt. to *Engineer*), 1932, **8**, 165–167).—A brief discussion including an illustrated account of the RWR casting process for aluminium, *Metallwirtschaft*, 1932, **11**, 583–584 (see preceding abstract).—R. G.

Action of Chloride Flux on Oxides Contained in Aluminium. Takayasu Harada (*Suiyokwai-Shi*, 1932, **6**, 807–816; *C. Abs.*, 1932, **26**, 5046).—[In Japanese.] Melted aluminium containing about 2·5% Al_2O_3 was treated with zinc chloride and titanium tetrachloride. The Al_2O_3 was decreased to about 0·45% in the best case. Chlorine and nitrogen gases decreased the Al_2O_3 to about 0·8%. H. concludes that the action of chloride flux in the removal of oxides in aluminium may be mechanical, as is that of chlorine and nitrogen.—S. G.

On the Normal and Inverse Segregation of Aluminium–Copper Alloys. Hans Bohner (*Metallwirtschaft*, 1932, **11**, 437–438).—On slow cooling of aluminium alloys with copper, the outside of the ingot is poorer in copper than the core. The difference increases at first with increase in the rate of cooling, then at a definite critical cooling rate changes its sign, and finally decreases further. This applies to alloys in the solid solution range (3% copper) as well as to those with more (up to 8·5%) copper.—v. G.

Studies on the Founding of Bronze. E. Moustacas *et al* (*Usine*, 1931, **40**, (5), 37).—Report of a discussion before the Association Technique de Fonderie, held in January 1931, and opened by M. If bronze castings are to be sold to specification it will be necessary to control the composition and mechanical properties of refined ingot metal which is very commonly used. Tensile and hardness tests, micrographic examination, and chemical analysis are considered necessary.—H. W. G. H.

Gas Porosity in Brass Castings. S. D. Tzypurdeev (*Metallurg* (*The Metallurgist*), 1932, **7**, (1), 84–93).—[In Russian.] The nature and cause of various defects which occur in brass castings are discussed with particular reference to the formation of gas-filled pores. This defect has given much trouble at the Koltchugin Works especially in casting Muntz metal and experiments on the laboratory and works scale have been made to discover the cause and means for its prevention. This paper records, however, only a summary of information already published on the subject together with an extensive bibliography.—M. Z.

The Melting of Thick Brass Castings : Bad Practice and its Consequences. Anon. (*Z. ges. Giesserei-Praxis*: *Das Metall*, 1931, **52**, 113–114).—It is difficult to make perfect large brass castings, and this is chiefly due to the use of unsuitable raw material, to overheating the molten brass, to melting for too long a time, to the use of unsuitable metal covers, and to lack of, or to insufficient, deoxidation. These faults and their effects are considered at some length and methods of obviating them are discussed. See also this *J.*, 1932, **50**, 196.—J. H. W.

Alloys for Pressure-Castings. N. F. Bolchovitinov (*Liteinoe Delo* (*Foundry Practice*), **1932**, (3), 17–20).—[In Russian.] Brief review of the present situation in this field.—N. A.

Moulds for Aluminium Die-Castings. Anon. (*Werkzeug* (Suppt. to *Maschinenkonstrukteur*), 1931, **7**, 139–140).—Continuation of a contribution to *Werkzeug und Werkstatt*, 1930, **24**. The present section describes the preparation of an improved mould for the die-casting of a motor-bonnet. A complete list of requisite pieces, with reference numbers to the accompanying diagrams, together with the appropriate material for each piece, and full details of the actual process are given.—P. M. C. R.

Casting Water-Meters in Wet Sand. A. Heinz (*Z. ges. Giesserei-Praxis* : *Das Metall*, 1932, **53**, 395–398).—The sand-mixing, mould preparation, and the making of a difficult casting, such as a water-meter, in wet sand are described.—J. H. W.

The Standardization of Patterns in the Foundry. —— Mantelet *et al* (*Usine*, 1931, **40**, (14), 27).—Report of a discussion held by the Association Technique de Fonderie and opened by M. The need for co-operation between the engineer, the founder, and the pattern-maker which might be based on some simple, standardized rules, is emphasized.—H. W. G. H.

Notes on Foundry Sands. F. A. W. Livermore (*Met. Ind. (Lond.*), 1932, **41**, 293–294).—Foundry sands are classified under 4 heads : (*a*) moulding sand; (*b*) core sand; (*c*) facing sand; and (*d*) parting sand. Typical analyses of each of these sands are given and the qualities required by each class are described.—J. H. W.

Grain-Size and Bond Distribution in Synthetic Moulding Sand. A. H. Dierker (*Trans. Amer. Found. Assoc.*, 1932, **40**, 230–238; discussion, 239–240). —A method for the microscopic examination of moulding sands is described. The distribution of bonding clay, its variation according to grain-size and time of milling, and the relation of surface area to grain-size are discussed, and the progressive improvement of bond distribution with milling is illustrated by photomicrographs. It is claimed that the permeability, bond and fineness of a sand can now be specified for any given type of casting.—P. M. C. R.

Materials Handling in the Small Brass Foundry. D. G. Anderson and B. F. McAuley (*Trans. Amer. Found. Assoc.*, 1932, **40**, 310–321; discussion, 321–324; and (abstract) *Foundry Trade J.*, 1932, **46**, 289–290).—The introduction of mechanical handling and electrical melting into a small brass foundry turning out a wide variety of non-ferrous castings is described, with special reference to sand-conditioning, conveyance, and control, and to moulding and pouring equipment and procedure. It is stated that a uniform grade of sand can be used for many different types of casting, and that its employment makes it possible to use a single sand-conditioning unit. Unjacketed moulds can safely be moved into position on roller conveyors. Specially designed tumbling barrels are used for the rapid sand-blasting of small or medium castings, whilst a sand-blast cabinet is used for large work. High-quality metal can be produced from scrap by melting in an electric arc furnace. In the discussion, the questions of conveyor speeds and of sand sampling are raised.—P. M. C. R.

How Much Does it Cost to Train Foundry Apprentices ? J. Franklin Carlz (*Trans. Amer. Found. Assoc.*, 1932, **40**, 217–229).—A consideration of the cost of a training course for foundry apprentices, established in 1927, shows that the cost per apprentice per year ($176.54) is more than balanced by increased and improved production.—P. M. C. R.

Present Tendencies in the Foundry. E. Ronceray (*Usine*, 1931, **40**, (Special No.), 51–54).—Reviews progress in foundry organization, technique, and equipment as indicated by the Paris Fair.—H. W. G. H.

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

On the Re-Working of Dirty Aluminium Residues. Anon. (*Metallbörse*, 1932, **22**, 578).—A brief review of recent articles on the subject by R. J. Anderson.—A. R. P.

The Melting of Aluminium Borings and Turnings. A. E. (*Machinery (Lond.*), 1932, **39**, 502).—Workshop notes. Hand-puddling must be used, or suitable fluxes stirred in, to promote coalescence of oxide-coated globules.—J. C. C.

The Melting of Aluminium Borings and Scrap. A. E. (*Machinery (Lond.*), 1932, **39**, 637).—A note. Figures are quoted for the recoveries obtained in American practice when remelting various classes of scrap.—J. C. C.

New Scrap Classifications on Red Grades [and] Aluminium Adopted at Convention. Anon. (*Daily Metal Reporter*, 1932, **32**, (52), 9).—An account of a meeting of the National Association of Waste Material Dealers at which the classifications of certain types of scrap brass, and new, pure aluminium clip-

pings, new and old, pure aluminium wire and cable, old scrap sheet aluminium, and scrap aluminium castings, were revised.—P. M. C. R.

The Remelting and Refining of Old Copper for the Manufacture of Rolling Ingots, Billets and Plates. Richard Thews (*Metallbörse*, 1932, **22**, 161–162, 193–194).—A brief description is given of the refining of scrap copper in reverberatory furnaces by a blast of hot air, the various stages in the deoxidation of the product and the methods of casting to obtain sound ingots for subsequent working. An account is also given of the effects of small quantities of impurities and of various devices which have been adopted to mitigate or overcome these defects.—A. R. P.

Recovery of Gold and Silver [from Jewellery Scrap]. Anon. (*Metallwaren-Ind. u. Galvano-Tech.*, 1932, **30**, 318).—To recover gold from gold–copper alloys which cannot be parted in nitric acid, the alloy scrap is dissolved in aqua regia, any silver chloride being filtered off, and the filtrate treated with an excess of caustic potash to precipitate the copper, leaving a solution of potassium aurate from which the gold is recovered by addition of hydrogen peroxide. A method for recovering silver from copper–silver alloy scrap is briefly outlined.—A. R. P.

Precious-Metal Scrap. Anon. (*Metallurgia*, 1932, **6**, 114).—The description of a process for the recovery of gold, platinum, palladium, and iridium from jeweller's scrap. Heterogeneous scrap is melted and cast into bars, which are dissolved in molten lead and the base-metal impurities removed by oxidation before cupellation. The precious metals are then cast into anodes and electrolysed, when the silver is deposited on the cathode and the other metals are collected at the anode as slimes, which are treated chemically and separated in the order iridium, gold, platinum, and palladium. Rich scrap is cast directly into anodes and electrolysed.—J. W. D.

On the Treatment of Residues Containing Precious Metals. W. Stein (*Mitt. Forschungsinst. Edelmetalle*, 1932, **6**, 19–25, 35–40).—Brief outlines are given of methods for the recovery of the precious metals from alloy scrap, doublé scrap, filings, old plating baths and wash-water, lemel, and hand-wash water.—A. P.

The Recovery of Precious Metals from Factory Waste. John S. Isdale (*Brass World*, 1932, **28**, 138–139).—Describes the recovery of precious metals by means of exhaust fans and collectors over buffing machines, burning wooden floors of workshops, the use of settling tanks, and by precipitation from electroplating solutions.—J. H. W.

On the Production of Remelted and Guarantee Zinc Low in Iron. Wilhelm E. Herrmann (*Chem. Zeit.*, 1932, **56**, 133–134).—The advantages and disadvantages of remelting zinc scrap in reverberatory furnaces and iron kettles are discussed at some length. Kettles are preferable for ferruginous zinc as the iron–zinc alloy rises to the relatively cool surface, whereas in the reverberatory furnace the surface of the metal is the hottest part of the charge, so that the iron tends to disperse throughout the metal and can be satisfactorily removed only by treatment with sulphur. The converse is true with regard to the removal of lead, the hot bottom of the kettles assists in distributing the lead throughout the zinc, whereas in the reverberatory furnace the lead settles readily to the hearth floor; by using a forehearth in addition, a further separation of lead may be effected. The reverberatory furnace yields a uniform high-grade product when large tonnages are to be treated, but the kettle is best for occasional charges. To prevent attack of the molten zinc on the iron of the kettle, a semi-steel, containing 2% manganese, should be used without removing the casting skin.—A. R. P.

Purchases of 654,890,231 Pounds of Scrap Analyzed. J. W. Furness (*Daily Metal Reporter*, 1932, **32**, (5), 4, 9, and 11).—From an analysis prepared by F., Chief of the Minerals Division of the U.S. Department of Commerce, of purchases of scrap metal in 1930.—P. M. C. R.

XV.—FURNACES AND FUELS

FURNACES

Basic Principles of Selection of Furnaces. R. J. Sarjant (*Metallurgia*, 1932, **6**, 147).—The selection of the most suitable type of furnace for a given operation depends on such factors as the adaptability value of the fuel, the reliability and flexibility of output, and the mechanical stability. These various factors are discussed, and particular reference is made to the case of control when using gas, oil, or electricity in preference to coal.—J. W. D.

Calculations for an Annealing Furnace. M. W. Groshev (*Metallurg (The Metallurgist*), 1932, **7**, (1), 39–63).—[In Russian.] Detailed calculations for the design, operation, heat-balance, etc., of an annealing furnace selected for installation at the Ural Machinery Works, Sverdlovsk.—M. Z.

Gas-Furnace Attains Temperature Exceeding Melting Point of Platinum. Anon. (*Eng. and Min. J.*, 1932, **133**, 449–450).—Operating on the principle of surface combustion, in contact tubes possessing a highly reactive surface a Degussa Lilliput furnace is claimed to be able to attain a temperature of 1,850° C. Favourable thermal conditions are obtained by symmetrical distribution of the flame, low resistance to the flow of gas and air, and effective insulation. Corundum and magnesia are used for the construction of the furnace. Industrial furnaces for melting platinum and other metals of high melting points are lined with magnesia or zirconia.—R. Gr.

Industrial Furnaces for Gas. Lawrence E. Biemiller (*Amer. Gas J.*, 1932, **137**, (3), 26–28).—Cf. this *J.*, 1932, **50**, 130, 270. Gas-fired ovens for japanning and metal decorating (lithographing) are briefly described.—J. T.

Wild-Barfield Low-Temperature Electric Furnace. Anon. (*Machinery (Lond.*), 1932, **39**, 459).—Cf. this *J.*, 1932, **50**, 643. An illustrated description of an electric furnace with forced-air circulation for temperatures up to about 700° C.—J. C. C.

Non-Oxidizing Electric Furnace. Anon. (*Machinery (Lond.*), 1932, **39**, 596–597).—An electric resistance furnace is described in which a non-oxidizing atmosphere is maintained by introducing gas through a special type of distributor. In this way a gas curtain is formed wherever there is any possibility of an air inflow.—J. C. C.

1-Ton High-Frequency Electric Furnace. Anon. (*Machinery (Lond.*), 1932, **39**, 537).—A brief description of a Metrovick 1-ton high-frequency electric furnace, operating at 500 cycles, 2000 v.—J. C. C.

Melting and Annealing Furnaces for Aluminium and its Alloys. —— von Zeerleder (*Congrès internat. mines. Liége*, 1930, June 22–28; also *Métallurgie*, 1930, 611–620; and (abstract) *Technique moderne*, 1930, **22**, 731; *C. Abs.*, 1932, **26**, 4281).—A review of progress effected during the last 10 years in melting and annealing furnaces for aluminium and its alloys.—S. G.

Electric Annealing Furnaces. A. G. Robiette (*Papers Swansea Tech. Coll. Met. Soc.*, 1932, 1–23).—Following a brief historical review of electric furnaces, R. surveys the economic aspect of electric heating. Principles governing the construction of furnaces are dealt with from the points of view of resistor elements, refractory lining and thermal insulation. Examples are given of the application of electric furnaces for industrial purposes.—R. Gr.

Furnace Atmospheres. S. Tour (*Canad. Mach.*, 1932, **43**, (8), 31).—From an address at a Toronto meeting of the American Society for Steel Treating. Furnace atmospheres are classified as transient or quiescent; the former are subdivided according to the fuel employed, variations in the quality of which, with incompletely controlled ventilation, frequently lead to inefficient running. Atmospheres of the oxidizing, reducing, and "neutral" type, with their special applications, are discussed, and applied also to the "quiescent" type of furnace, which includes the electrically heated furnace and the muffle.

—P. M. C. R.

FUELS

Large Scale Brass Annealing in Gas-Fired Muffles. W. Wirt Young, Jr. (*Gas Age-Record*, 1931, **68**, 907–908, 923).—Details are given of the construction and operation of a continuous brass coil-annealing furnace, 30 ft. × 8 ft. × 7 ft., fired with town's gas, using surface combustion high-pressure burners. Production capacity is 5,000–6,000 lb. of net brass per hr., heated to 1100°–1250° F. (593°–677° C.). Gas consumption (cal. val. 530 B.Th.u. per ft.³) is 0·66 ft.³ of gas per lb. of net brass annealed. Gas is being applied in the following operations: non-oxidizing annealing of brass and nickel–brass, bright-annealing of brass wire and strip, heating of brass and nickel–brass billets for extrusion, and heating of brass for drop-forging.—J. S. G. T.

Results Obtained by Industrial Gas Research. J. F. Quinn (*Gas Age-Record*, 1931, **68**, 49–52).—Developments in the application of gaseous heating to the following processes are very briefly referred to: brass melting and bright-annealing, stereotype metal melting, zinc-base die-casting, and the development of various types of burners and furnaces.—J. S. G. T.

Industrial Gas Research and Its Relation to Gas Sales. N. T. Sellman (*Gas Age-Record*, 1931, **68**, 685–687).—It has been established that sand cores are best baked by convected heat. Immersion heating has been extended to melting soft metals other than stereotype metal.—J. S. G. T.

Gas in Pacific Coast Industries. Fred C. Dietrich (*Gas Age-Record*, 1931, **68**, 251–253, 282).—Applications of natural gas as fuel for soft metal melting, japanning, drying, and cleaning metals are briefly referred to.—J. S. G. T.

Gas Flames in Conversion to New Gases. R. B. Harper (*Gas Age-Record*, 1931, **68**, 735–740, 779–785, 811–818).—Fundamentals of gaseous combustion in industrial burners and factors concerned when a change occurs in the nature of the gas consumed are briefly described and illustrated.—J. S. G. T.

Selection, Utilization and Distribution of Gas Mixtures. J. A. Perry (*Gas Age-Record*, 1931, **68**, 679–682).—Factors entering into the choice of a gas mixture composed of coal gas, carburetted water gas, and water-gas for any definite heating process are discussed.—J. S. G. T.

Tentative Revisions of A.S.T.M. Standards. Standard Definitions of Terms Relating to Coal and Coke (D 121–30). —— (*Amer. Soc. Test. Mat. Tentative Standards*, 1932, 1165).—The " Tentative Definition of the Term Coke " (see following abstract) is intended to be added, when adopted, to the present standard definitions.—S. G.

Tentative Definition of the Term Coke (D 121–30 T). —— (*Amer. Soc. Test. Mat. Tentative Standards*, 1932, 713).—See this *J.*, 1930, **44**, 720.—S. G.

The Use of Coal in the Melting and Heating of Metals. R. J. Sarjant (*Metallurgia*, 1932, **6**, 149–152).—The characteristic of coal from the aspect of its use as a furnace fuel is discussed as a result of the research work which has been carried out to elucidate its physical and chemical properties. Detailed consideration is given to the composition and heating value of coal, to its behaviour on heating, and to clinkering properties. The utilization of coal for melting, reheating, and heat-treatment furnaces is fully dealt with, and the question of smoke emission referred to.—J. W. D.

Some Future Fuel Problems in Metallurgical Practice. H. C. Armstrong (*Proc. 3rd Internat. Conference Bituminous Coal*, 1932, **1**, 652–656; *C. Abs.*, 1932, **26**, 4694).—The problems are: (1) future use of high-sulphur coal; (2) cleaning of fuel gas; (3) automatic thermostatic control, and (4) smoke elimination.—S. G.

Experiments for the Production of a Coke Useful for Smelters and Foundries by the Mixing of Coals of Different Qualities. Erich Koch (*Ges. Abhandl. Kenntnis Kohle*, 1930, **9**, 367–375; *C. Abs.*, 1932, **26**, 4446).—The proportion of the various coals used and a special method for determining this proportion are given.—S. G.

Mechanism of Combustion of Pulverized Coal. A. Grebel (*Proc. 3rd Internat. Conference Bituminous Coal*, 1932, **2**, 420–447).—S. G.

The Effective Combustion of Coal, with Special Reference to Pulverized Fuel. Anon. (*Fuel Economist*, 1932, **7**, 511–518).—The composition of coal, processes involved in combustion, the burning of coal in stokers, and the effective combustion of pulverized coal, which is largely dependent on the type of burner employed, are briefly discussed. Modern types of burners, including the turbulent and tangential types, are described.—J. S. G. T.

A Brief Résumé of Information on the Storage of Coal. (Sir) Frederic L. Nathan (*Fuel Econ. Rev.*, 1932, **11**, 5–8).—Literature relating to phenomena associated with the spontaneous heating of coal in store is briefly reviewed. Factors affecting oxidation and heating of stored coal include (1) type of coal; (2) size of coal; (3) accessibility of air; (4) presence of pyrites, or (5) moisture, and (6) temperature. Coal should be stored on dry, level, well-drained ground, cleared of vegetation. Coal consisting of lumps with little or no dust should have ventilating channels made in it; channels in the case of dusty coal are a potential source of danger.—J. S. G. T.

Use of CaO in the Determination of S in Coals by the Eschka Method. N. J. Ivison (*Fuel*, 1932, **11**, 23–24).—Lime may be substituted for magnesium oxide in the analytical procedure, but is not so satisfactory when the sulphur content of the coal is high.—E. S. H.

Diffusion Combustion. W. M. Hepburn (*Metal Progress*, 1932, **22**, (3), 24–28).—Combustion of this type is produced by the diffusion of oxygen from a stream of air into a parallel stream of gas : such combustion is confined to a surface, the " flame front," the form, size, and luminosity of which are capable of exact control. The method of combustion is claimed to give constant emissivity and uniform carbon precipitation, maximum free carbon content, constant flame temperature over the determined length of flame projection, and exclusion of atmospheric gases by maintaining, if desired, a protective layer of sooty gas. This combination is said to result in quicker heating, lower furnace temperature, accurate control, and good surface condition of product. Types of burner and furnace are described.—P. M. C. R.

Determination of Sulphur in Coal by the Perchlorate Method. G. Frederick Smith and A. Garrell Deem (*Indust. and Eng. Chem. (Analyt. Edn.)*, 1932, **4**, 227–229).—The coal (1 grm.) is treated with 1 grm. KNO_3, 5 c.c. HNO_3 (d 1·4), 0·16 grm. NH_4VO_3. 2–4 grm. $CH_2ClCOOH$, and 15 c.c. of 70% $HClO_4$, and the mixture is shaken for 10 minutes at 120° C., then heated to 180–185° C. until all organic matter is oxidized and a precipitate of V_2O_5 formed. After cooling somewhat, 5–10 c.c. HCl (d 1·19) are added and the mixture is again heated until V_2O_5 separates. The product is boiled with 100 c.c. H_2O and 0·2 grm. $NH_2OH \cdot HCl$, the insoluble material separated, and the S precipitated with $BaCl_2$. The results are usually about 0·3% lower than those obtained by the Eschka process, probably owing to more complete removal of the SiO_2. The method is not applicable to the analysis of coke.—A. R. P.

Comparative Tests on the Determination of the Total Sulphur in Coal by the Methods of Hackl and Eschka. C. Otin and C. Cotrutz (*Brennstoff-Chem.*, 1932, **13**, 126–127).—Both methods give equally good results, but Hackl's method requires a longer period of heating.—A. R. P.

On the Determination of Sulphur in Coal and Coke. Rudolf Lanzmann (*Brennstoff-Chem.*, 1932, **13**, 167).—The Eschka method gives good results even when much sulphur is present, whereas the calorimeter combustion method often gives erratic results when the sulphur content is high.—A. R. P.

XVI.—REFRACTORIES AND FURNACE MATERIALS

The Properties and Uses of the More Important Refractory Materials. Geoffrey Staniland and G. W. Lee (*Eng. Rev.*, 1932, **45**, 701–703).—Factors affecting the melting point of refractories are discussed, and the use of Seger cones is described. Permanent and reversible thermal expansion, thermal conductivity, porosity, chemical, and mechanical properties are considered, and suitable materials for various purposes are selected on the bases previously indicated.—P. M. C. R.

The Characteristics of Firebricks under Working Conditions. Anon. (*Eng. Rev.*, 1932, **45**, 704–706).—The severe requirements of modern furnace practice necessitate careful selection of firebrick. This involves the following factors : working temperature, texture, chemical composition, and density. Causes of failure are examined, and the use of plastic refractories for repairs is advocated.—P. M. C. R.

Developments in Unburned Magnesite Brick. A. E. Fitzgerald (*Blast-Fur. and Steel Plant*, 1932, **20**, 658–666).—Cf. this *J.*, 1932, **50**, 397. Traces the development of the use of magnesite. The manufacture of bricks and the testing of unburned magnesite, burned magnesite, and chrome brick are also dealt with.—R. Gr.

Raw Materials for Silica Brick Manufacture. Norman H. Stolte (*Ceramic Age*, 1932, **19**, 255–256).—A review.—E. S. H.

Tentative Method of Control Test for Resistance of Fireclay Brick to Thermal Spalling Action (C 38–31 T). —— (*Amer. Soc. Test. Mat. Tentative Standards*, 1932, 410–411).—See this *J.*, 1932, **50**, 201.—S. G.

Tentative Revisions of A.S.T.M. Standards. Standard Definitions of Terms Relating to Refractories (C 71–31). —— (*Amer. Soc. Test. Mat. Tentative Standards*, 1932, 1146).—Several definitions of terms published under the title " Tentative Definitions of Terms Relating to Heat-Transmission of Refractories " (see following abstract) are intended to be added, when adopted, to the present standard definitions.—S. G.

Tentative Definitions of Terms Relating to Heat Transmission of Refractories (C 71–31 T). —— (*Amer. Soc. Test. Mat. Tentative Standards*, 1932, 415–416).—See this *J.*, 1932, **50**, 201.—S. G.

XVII.—HEAT-TREATMENT

Short-Time Annealing of Aluminium Strip and Sheet in the Continuous Electric Annealing Furnace. H. Masukowitz (*Z. Metallkunde*, 1932, **24**, 236–239; discussion 239; and (translation) *Light Metals Research*, 1932, **2**, (16), 2–10).—The superiority of continuous annealing furnaces in the manufacture of high-quality metal strip for deep-drawing purposes is emphasized. The change in the Erichsen value of 1 mm. aluminium sheet during heating in a furnace maintained between 630° and 800° C. indicates that with furnace temperatures of at least 700° C. the shortest possible period of annealing has a favourable influence on the Erichsen value and that short-time annealing at 420°–550° C. results in practically the same high Erichsen value. Large scale experiments with aluminium strip have shown that annealing in a continuous furnace results in higher and more uniform Erichsen values than annealing in a muffle furnace.—M. H.

Heat-Treating and Forging Some Light Alloys. W. C. Devereux (*Metallurgia*, 1932, **7**, 17–18).—A discussion of a paper by D. to the Sheffield Society of Engineers and Metallurgists indicates the need for care and control in working Duralumin, " Y " alloy, and the " R.R. " alloys. Control of furnaces;

blistering; the use of forged bars and extruded or rolled bars for stampings; grain-growth; age-hardening; and proper heat-treatment temperatures are considered. Special reference is also made to a new type of test carried out on the Amsler repeated impact testing machine, which gives marked differences in the results between various materials. A new etching solution of hydrofluoric acid and sulphuric acid is suggested for showing the presence of cracks or defects in forgings (cf. following abstract).—J. W. D.

Heat-Treating and Forging Some Light Alloys. D. R. Tullis. W. C. Devereux (*Metallurgia*, 1932, **7**, 59).—Correspondence between T. and D. regarding D.'s paper (preceding abstract). The phenomena of grain-refining growth in aluminium alloys, when soaked at forging temperature; and the mechanism of age-hardening are further discussed.—J. W. D.

The Condition of Cooling of Duralumin Forgings. W. M. Aristov (*Niimash Izvestia Nauchno-issledovatelskogo Instituta Mashinostroenia i Metalloobrabotki* (*Bulletin of the Scientific Research Institute of Machine Building and Metal Treatment*), **1932**, (5–6), 267–277).—[In Russian.] Duralumin has a tendency to self-quenching during the process of cooling, even if the final forging temperature is 350° C. The depth of the air-quenched layer of Duralumin is very small and can be removed by turning. Mechanical tests have shown that the parts which cool most rapidly undergo work-hardening while being forged. Forgings which have sharp variations in cross-section must be cooled in warm sand after being worked.—N. A.

Investigation of the Heat-Treatment of " Y " Alloy. M. Scharov and N. Merkuriev (*Tehnika Vosdushnogo Flota* (*Technics of the Aerial Navy*), 1932, **6**, (3), 260–284).—[In Russian.] Optimum mechanical properties are obtained by the following heat-treatment : annealing at 520 $\pm$ 5° C. for 4 hrs., quenching in boiling water and ageing at 200° C. for 12 hrs., or at 225° C. for 3 hrs. The mechanical properties of " Y " alloy are approximately equal to those of " No. 12 " alloy at room temperature but markedly superior at higher temperatures after 300° C. —N. A.

Bright-Annealing Copper Wire in an Atmosphere of Steam. J. B. Nealey (*Gas Age-Record*, 1932, **70**, 111–112, 119).—Plant comprising a gas-fired steam superheater for bright-annealing copper wire in a current of steam is described.
—J. S. G. T.

XVIII.—WORKING

The Mechanism of Plastic Deformation (Extrusion of Duralumin). S. I. Gubkin (*Niimash Izvestia Nauchno-issledovatelskogo Instituta Mashinostroenia i Metalloobrabotki* (*Bulletin of the Scientific Research Institute of Machine Building and Metal Treatment*), 1931, (8), 363–390).—[In Russian.] Extrusion tests on Duralumin, have been carried out with a Gagarin press at temperatures of 20°, 100°, 150°, 200°, 250°, 300°, 400°, and 500° C. using dies of different sizes. In the graph of the logarithm of the maximum " steady extrusion pressure " against temperature, 4 straight-line sections occur at : (i) below 100° C.; (ii) 100°–200° C.; (iii) 200°–400° C.; and (iv) 400°–500° C. The discontinuities must represent some changes which must occur between 100° and 200° C. and at about 400° C. A detailed mathematical analysis of the extrusion process in a plastic mass is given. Hardness at high temperatures was determined by 3 different methods : (i) Brinell, the tests being carried out on Gagarin's press; (ii) Brinell, under a static load ; (iii) dynamically by the falling ball method. The curves of variation of hardness with temperature are analogous to the extrusion pressure curves. The influence of velocity on the magnitude of the deformation stress is small at low temperatures, begins to be marked at 200° C. and becomes greater at higher temperatures.—N. A.

The Theory of Difference of Principal Stresses in its Application to the Processes of Drawing and Pulling in Dick's [Extrusion] Press, &c. S. I. Gubkin (*Niimash Izvestia Nauchno-issledovatelskogo Instituta Mashinostroenia i Metalloobrabotki* (*Bulletin of the Scientific Research Institute of Machine Building and Metal Treatment*), **1931**, (9) 471–483).—[In Russian.] Mohr's theory of differences of principal stresses is entirely applicable to the analysis of the technical processes employed in the working of metals under pressure. The stress δ created by the drawing process may be determined by the formula :

$$\delta = \left(\frac{V_d}{V_e}\right)^{\frac{1}{c_1}} \left\{ (p_0 + b)\frac{m_2}{m_1}\left[1 - \left(\frac{D_2}{D_1}\right)^{m_1}\right] - \frac{bm_2}{m_1 + n}\left(\frac{D_0}{D_1}\right)^a \left[\left(\frac{D_1}{D_2}\right)^n - \left(\frac{D_2}{D_1}\right)^{m_1}\right] \right\}$$

where V_d is the rate of drawing, V_e the rate of elongation, p_0 the limit of flow of the non-work-hardened material, $1/c_1$ a coeff. depending on the properties of the metal, and b a constant depending on the tendency of the metal to increase in strength; $m_2 = 2\left(1 + \frac{\mu}{\tan\alpha}\right)$, $m_1 = \frac{2\mu}{\tan\alpha}$, where μ is the coeff. of external friction, α the angle of the die aperture, D_1 the diameter before, D_2 the diameter after, and D_0 the initial diameter during, drawing, α the coeff. of correction for the irregularity of stress through the cross-section of the wire due to inaccuracy in the angle of the die, and n a constant depending on the properties of the metal. This theory is also applicable to extrusion with Dick's press, the formula then being :

$$\delta_l = \left(p_0 + b\right)(1 + Z)\left[\left(\frac{D_1}{D_2}\right)^{2/z} - 1\right] - \frac{2b(1 + Z)}{2 + 2Zn}\left(\frac{D_0}{D_1}\right)^n \left[\left(\frac{D_1}{D_2}\right)^{2/z}\left(\frac{D_1}{D_2}\right) - 1\right]$$

where $Z = \frac{\tan\alpha}{\mu}$, and δ_l the extrusion pressure. All the other symbols being as before. To check the formulæ, experiments were performed, the results of which were as follows (extrusion pressures in kg./mm.^{2}, the calculated value being in brackets) : aluminium, 88·5, (93·7); Duralumin, 162·2, (169·2); brass I, 125·4, (132·3); brass II, 137·8, (145·1).—N. A.

Improvements in the Cold-Working of Metals. J. R. Miller (*Heat-Treat. and Forging*, 1931, **17**, 559–561; and (summary) *Metallurgist* (Suppt. to *Engineer*), 1931, **7**, 138–139).—It is claimed that a combination of rolling and drawing produces less directional distortion in the material than do ordinary cold-rolling or cold-drawing methods. X-ray patterns of cold-rolled strips before and after annealing are compared with analogous patterns produced by material made by the combined process. The four-high mill used in production is described; in it strip may be reduced without interruption to the thinnest commercial gauges. The process can be applied to brass, bronze, hard chrome–nickel alloys, and carbon-steels. A great economy is effected by the saving of annealing costs.—P. M. C. R.

Use of a Lead Coating in the Cold-Working of Metals. G. de Dudzecle (*Congrès internat. Mines, Liége*, **1930**, June 22–28; and *Métallurgie*, **1930**, 499–506; *Chim. et Ind.*, 1932, **27**, 1076–1077; *C. Abs.*, 1932, **26**, 4283).—The surfaces of metals can be covered with a thin layer (0·012–0·015 mm.) of lead, which facilitates cold-working of the metal more than the copper coating generally used for the same purpose, and can be removed electrolytically or chemically without affecting the underlying metal in any way. The advantages of such lead coatings are discussed.—S. G.

Researches on Tube Drawing. W. Jung-König, W. Linicus, and G. Sachs (*Metallwirtschaft*, 1932, **11**, 395–401; and (summary and discussion) *Metallurgist* (Suppt. to *Engineer*), 1932, **8**, 136–138).—The power consumption and change in properties of brass and Lautal tubes have been determined when the metal is drawn over a stationary mandrel and when drawn with a core. The

power consumption has been calculated in relation to the reduction in area and the shape of the die; it can be considerably reduced by careful polishing of the die. The hardening of the metal is less than is the case in wire drawing, which indicates that there is a greater homogeneity in the deformation in tube drawing. The internal stresses in the drawn material are greater the steeper is the die angle; it, therefore, appears to be possible to reduce the danger of splitting by using a slender die angle for the last draught, as the deformation in this stage determines the internal stress.—v. G.

A New Type of Roll for the Cold-Rolling of Metals. F. Krau (*Z. Metall-kunde*, 1932, **24**, 226–228; discussion, 228–229).—The requirements of rolls for · the cold-rolling of high-quality aluminium, copper, nickel, iron, and brass are given. The manufacture, properties, and microstructure of a special type of chill-cast roll are described.—M. H.

The Problem of Cold-Compressing in the Manufacture of Screws. W. Aumann (*Z. Metallkunde*, 1932, **24**, 200–206).—A mathematical and technological treatment of the cold-compressing process for screws, for which the original paper must be consulted. Compression diagrams (compression depending on tension of pressure—" Druckspannung ") are given of 72 : 28 brass, iron, nickel, zinc, and Duralumin.—M. H.

Forging and Stamping of Duralumin. A. Vella-Ferrand (*Usine*, 1931, **40**, (12), 37–41).—A description of the practice adopted at the Forges de Foulain and the Forges de Bologne. The material is received in the form of annealed bar which is examined visually and tested for tensile properties, hardness, and density. It is cut, by circular or band saws, into pieces which are heated in electric resistence furnaces, thermostatically controlled at a temperature between 400°–430° C. Stamping is often preceded by a hand-forging operation to obtain the approximate shape of the finished article. The dies are made from nickel–chrome–molybdenum steel and must be very highly finished. They are designed to produce the most satisfactory distribution of the " fibres " of the metal, which is investigated by macro-etching. After each stage of fabrication, the forgings are etched in hot caustic potash and examined for flaws. Heat-treatment is carried out either in electric furnaces or gas-heated salt baths.—H. W. G. H.

Forging and Stamping of Duralumin. (Experimental Work.) W. M. Aristov and N. I. Korneev (*Niimash Izvestia Nauchno-issledovatelskogo Instituta Mashinostroenia i Metalloobrabotki* (*Bulletin of the Scientific Research Institute of Machine Building and Metal Treatment*), 1931, (11–12), 606–622).— [In Russian.] The information given is now well known.—S. G.

The Deformation of Duralumin by Forging at High Temperatures. E. F. Bachmetew and S. I. Gubkin (*Niimash Izvestia Nauchno-issledovatelskogo Instituta Mashinostroenia i Metalloobrabotki* (*Bulletin of the Scientific Research Institute of Machine Building and Metal Treatment*), 1932, (2), 85–97).—[In Russian.] A method of testing Duralumin undergoing deformation by forging at high temperatures is worked out, by which it is possible to obtain preliminary curves for the so-called " true " stresses due to the compression exerted by the blow. The tests were carried out at 450° C. The increase in hardness after deformation at the above temperature is slight, and may be neglected in the preliminary calculations. The rate of recrystallization under the conditions of the experiments is less than that of deformation, with the result that a structure similar to that after deformation in the cold, is obtained. X-ray analysis, however, shows that after forging at 450° C. the distortion of the crystal lattice is less; this is confirmed by a study of the hardness.—N. A.

Investigation of the " Critical Interval " in Work-Hardening of " German Silver " and "Aluminium–Bronze." W. S. Bugakov (*Zhurnal Tehnicheskoy Fiziki* (*Journal of Technical Physics*), 1932, [B], **2**, (2), 173–189).—[In Russian.] Changes in mechanical properties, solubility, electrical resistance

density, and residual strain of " German silver " and " aluminium–bronze " for different degrees of work-hardening indicate that a " critical interval " exists between a 20–30% degree of work-hardening, within which a sharp change in properties occurs. At this stage, there is a radical alteration in the relative positions of the crystal axes. In " aluminium–bronze," lines due to twinning appear at 20% work-hardening.—N. A.

Manufacture of Zinc Vessels for Dry Batteries. Wolfgang Litten (*Maschinenbau*, 1932, **11**, 344–346).—Zinc cups for dry batteries are frequently made by bending up sheet and soldering or welding the overlapping joint. Better cups are, however, obtained by deep-drawing or hot extrusion. In deep-drawing the original sheet must be of quite even thickness and the surface of the drawing tool must be quite smooth.—v. G.

Operation of a Directly-Driven 1500-Ton Press at a Pressure of 300 Atmospheres.—I–II. Chr. Bernhoeft (*Z. Metallkunde*, 1932, **24**, 210–213, 261–263). —(I.) Large-scale extrusion experiments with copper, aluminium, brasses, special brasses, &c., with variation of the rate of extrusion, pressure, length of the ingot, and cross-section of the extruded rod are described. (II.) An illustrated description is given of experiments made to elucidate the mechanism of flow during extrusion.—M. H.

The Life of Presses. W. Sack (*Werkzeug* (Suppt. to *Maschinenkonstrukteur*), 1931, **7**, 185–186).—The choice of materials is of great importance in view of the combined or alternating effects of tension, compression, bending, and torsion to which pressing machinery is exposed. Although a heavy press entails slower working and greater power consumption, the increased running cost is balanced by greater reliability, fewer breakdowns, and consequent steadier production. Cases of breakdown are discussed and causes of failure analyzed. Among these were overloading, small local defects, poor finish, and fatigue. Questions of repair and maintenance are considered.—P. M. C. R.

The Working of Aluminium. Anon. (*Werkzeug* (Suppt. to *Maschinenkonstrukteur*), 1931, **7**, 45).—Appropriate speeds of cut and feed and optimum depth of cut for the machining of aluminium are discussed.—P. M. C. R.

The Machining of Light-Metal Connecting Rods. Anon. (*Werkzeug* (Suppt. to *Maschinenkonstrukteur*), 1931, **7**, 89).—The (multiple) grinding of the rod-heads, drilling of oil-holes, preparation of the bolt-sockets, and exact machining of the bearings are carried out in much reduced time by the special machinery described.—P. M. C. R.

Haynes Stellite Cutting Tools. W. A. Becker, E. E. Gordon, and W. A. Wissler (*Trans. Amer. Soc. Mech. Eng.*, 1931, **53**, MSP.11a, 93–100; and (abstract) *Machinery (N.Y.)*, 1931, **37**, 369–370).—Describes briefly the physical properties of Stellite and gives the more important details of several types of machining operations in which it is being successfully used. Its most important property is red hardness. Measurements of hardness were made by an improved method up to 1100° C. The resulting data show that the cobalt–chromium–tungsten alloy is harder than high-speed steel at temperatures above 500° C. This is believed to account for its superior cutting quality. In general, Stellite bits can be used economically on all operations on cast iron, semi-steel, malleable iron, bronze, or similar metals, and on mild steel if the section is heavy and the tools are rigidly supported. It has not been successful on automatic or semi-automatic machines for cutting steel.—S. G.

Production of Hard Fusible Alloys for Tools. Anon. (*Werkzeug* (Suppt. to *Maschinenkonstrukteur*), 1931, **7**, 685).—The structure of tungsten carbide is traced from solidification-point to red heat, and the effect on hardness of facilitating or suppressing the various transformations by varying the rate of cooling is discussed. Modification by the partial or complete substitution of molybdenum or chromium for tungsten, and of boron or titanium for silicon, is possible, and suitable adaptations of furnace conditions are suggested.—P. R .

Diamond and Widia. F. K. Böck (*Maschinenkonstrukteur*, 1931, **64**, 220–223).—The sources of diamonds are considered. The preparation and properties of Widia are discussed, and the advantages and limitations of each as a cutting material are compared. B. considers that for many purposes diamond is superior to Widia and allied materials, and states that in view of its long life and superior performance the cost for small work is not prohibitive. Wider application should accompany a fall in the price of the material.—P. M. C. R.

High-Duty Cutting Materials. Anon. (*Werkzeug* (Suppt. to *Maschinenkonstrukteur*), 1931, **7**, 85–87).—The preparation, mounting, brazing, and setting of tungsten carbide tools are discussed. The development of Widia and other tungsten carbide products (Carboloy, Diamondite, Strauss-metal) is traced, and the performance of Widia tools is discussed, and compared with that of Stellite, which is recommended for materials of intermediate hardness.
—P. M. C. R.

High-Duty Cutting Tools [Brazing]. Anon. (*Werkzeug* (Suppt. to *Maschinenkonstrukteur*), 1931, **7**, 59).—Directions are given for the attachment of Widia tools to steel holders. Grooving should be avoided, and the tool should be fixed by brazing only; for this copper is preferred to brass. The tool should be embedded after brazing in powdered charcoal, and, until this ceases to adhere to the joint, should not be placed in sand.—P. M. C. R.

Hard Metals in Operation. B. Fetzer (*Werkzeug* (Suppt. to *Maschinenkonstrukteur*), 1931, **7**, 216–219).—High-speed tool materials are classified and discussed, with comparative figures for Brinell hardness and tensile strength. Performance figures are given for Widia tools on cast-iron of various types, cast and forged mild steel, special steels, bronzes, brasses, copper, aluminium, and certain non-metallic insulators. Cutting speed, cutting angle, necessary modifications in machinery, and lubrication are discussed, and a table of cutting speeds and lubricants for sawing is given. This includes saws of all types of steel, and varying degrees of fineness, and the optimum conditions of their use with a wide range of ferrous and non-ferrous metals and alloys.
—P. M. C. R.

The Economical Use of Old Machinery with the Help of Special Adaptations. Alfred Winter (*Werkzeug* (Suppt. to *Maschinenkonstrukteur*), 1931, **7**, 197–200).—Modernizing adaptations of old types of grinding machinery are fully described, with illustrations.—P. M. C. R.

XIX.—CLEANING AND FINISHING

Cleaning Aluminium. Anon. (*Amer. Machinist* (*Eur. Edn.*), 1932, **76**, 973).—The types of cleaning solution suitable for degreasing aluminium are : (1) volatile solvents such as petrol, kerosene, carbon tetrachloride, and triethylchlorine; (2) water solutions of soap and alkalis of a mild nature; (3) "water-soluble controlled alkali" solutions. The make-up and methods of using these solutions are described. A matt finish is produced by attacking the surface with a strong alkali. A bright finish is produced by dipping the parts in a solution containing nitric acid 5 gall., hydrofluoric acid 1 gall., sulphuric acid 1 quart or nitric acid 8 parts, hydrofluoric acid 1 part.—J. H. W.

Pickling Sheet Metal and its Control. —— Lang (*Glashütte*, 1932, **62**, 490–491, 510–512; *C. Abs.*, 1932, **26**, 5525).—L. discusses in detail the pickling of raw ware, and emphasizes the necessity for control of : (1) the acid; (2) strength of the pickling bath; (3) the pickling time; (4) the wash water and the neutralizing solution especially—S. G.

Acid-Resisting Metals Used for Pickler's Racks. D. E. Stamm and J. C. Weaver (*Metal Progress*, 1932, **21**, (3), 61–64).—The old type of wooden rack can be economically replaced by considerably lighter baskets in acid-resisting alloy; improved designs for quick unloading are described. For heavy work

Monel metal or cast bronze compete with the ferrous alloys Duraloy (chromium–iron) and Durimet (chromium–nickel–silicon). The latter is recommended for use with sulphuric acid. Rubber-coated metal gives good results in hydrochloric acid pickling.—P. M. C. R.

Metals and Music. Gilbert E. Smith (*Met. Ind.* (*Lond.*), 1932, **40**, 465–466).—The metals used for making parts of various musical instruments and the reasons for using them are given, and in particular the use of bronzes in the manufacture of bells is discussed.—J. H. W.

On the Use of Sea-Water for Colouring Metals. Ernst Beutel and Artur Kutzelnigg (*Metallwaren-Ind. u. Galvano-Tech.*, 1932, **30**, 378–379).—Copper and its alloys can be coloured various shades of brown by immersion for various periods in hot sea-water containing hydrogen peroxide, sodium perborate, potassium ferricyanide, or potassium permanganate.—A. R. P.

Molybdenum in Metal Colouring. Georg Buchner (*Oberflächentechnik*, 1932, **9**, 14).—For colouring cadmium or zinc the metal is electrolytically oxidized in a 0·5–1% solution of ammonium molybdate containing ammonium sulphate. Other metals may be coloured by boiling in dilute molybdate solutions containing an addition agent, *e.g.* oxalic acid, fluorides, silicates, borates, or tungstates.
—A. R. P.

The Finishing of Brass Stampings for Automotive Hardware. Allen W. Carter (*Monthly Rev. Amer. Electroplaters' Soc.*, 1932, **19**, (7), 17–19).—Details of buffing, cleaning, and nickel and chromium plating operations are given briefly.—A. R. P.

Matting of Metals. Rudolf Plücker (*Metallwaren-Ind. u. Galvano-Tech.*, 1932, **30**, 317–318).—To obtain a yellow matt finish on copper, brass, bronze, and nickel–brass, the metal is dipped into a warm mixture of 200 parts of nitric acid, 1 part of sodium chloride and 1 part of soot, then into a hot mixture of 3 kg. of nitric acid, 2 kg. of sulphuric acid, 15 grm. of sodium chloride, and a solution of 10–15 grm. of zinc sulphate in 50 c.c. of water. To obtain a bright matt finish, the articles are then passed rapidly through a mixture of 50 parts of sulphuric acid, 100 parts of nitric acid, 1 part of sodium chloride, and 2 parts of soot, and to produce a matt-grained finish they are immersed for several hrs. in a mixture of 1 volume of saturated potassium bichromate solution and two volumes of concentrated sulphuric acid.—A. R. P.

XX.—JOINING

Apparatus for Turning the Ends of Tinned Copper Tubing [for Brazing]. Anon. (*Werkzeug* (Suppt. to *Maschinenkonstrukteur*), 1931, **7**, 242).—The tinned tubing was to be prepared for brazing on to other parts. The necessary adjustments are described and illustrated.—P. M. C. R.

Welding Processes Applicable to Aluminium. W. M. Dunlap (*Amer. Soc. Test. Mat. Symposium on Welding*, 1931, 24–27; and (abstract) *Iron Age*, 1931, **127**, 1203–1204).—The oxy-acetylene flame is usually employed for heavy gauge sheet and plate. The atomic hydrogen process has no advantages, but metallic arc welding has reached a position of considerable importance. The carbon arc is used to a less extent. Resistance welding is used extensively, but aluminium cannot be successfully flash welded. Percussion welding also finds considerable use for light repetition work.—H. W. G. H.

The Welding of Elektron in Aircraft Construction. Hans A. Horn and Karl Tewes (*Z. Flug. u. Motor.*, 1931, **22**, 609–662).—Welded Elektron parts included engine casing, tanks for fuel and oil, and tubular seats, and their use effects great economy in weight. Oxy-acetylene welding with Elektron wire is recommended; careful cleaning is necessary. The flux contains a high proportion of lithium salts and is rich in chlorides: it is applied fairly thickly on account of the protection it affords against fire.

Support, at distances varying with the thickness of the material, is needed to avoid distortion on account of the softening of the alloy. Butt-welding is necessitated to ensure the continual removal of the flux, and in any case is preferable to lap-welding. Methods of application are illustrated. Protection from atmospheric and other corrosive agencies is afforded partly by careful manufacture of the alloy, the resistance of which has been improved by certain additions; a chromate–saltpetre bath gives a protective coating. Annealing to 300° C. removes working stresses and gives additional strength.
—P. M. C. R.

Copper Alloy Welding Rods. I. T. Hook (*Iron and Steel Eng.*, 1931, **8**, 337–341).—The welding characteristics and strength of welds made in iron and steel with rods of deoxidized copper, common brass, Muntz metal, Tobin bronze, manganese bronze, phosphor-bronze, wrought nickel–silver, extruded nickel–silver, Ambrac, Monel metal, Everdur, golden and white brazing solder, and silver solder are briefly described. All rods require a flux with a borax or boric acid base preferably with the addition of a little sodium chloride or fluoride. All the above rods except those containing zinc can be used for arc as well as torch welding.—A. R. P.

Hard-Facing [with Stellite] in Industrial Fields. W. A. Wissler and A. V. Harris (*J. Amer. Weld. Soc.*, 1931, **10**, (2), 17–20; and (abstract) *Machinery* (*N.Y.*), 1931, **37**, 627).—Examples are given of the use of insets of Stellite for facing softer materials, including aeroplane tail skids and the steel rings of cement mills.—J. C. C.

Welding Inspection. R. Kraus (*Amer. Soc. Test. Mat. Symposium on Welding*, 1931, 141–151).—By watching the welding in progress and from the external appearance of the product, the inspector should be able to detect bad welding. The points he should notice are discussed and some simple non-destructive tests are described.—H. W. G. H.

Metallurgical Considerations on Welding. Franz Rapatz (*Stahl u. Eisen*, 1931, **51**, 245–253).—The effect on the quality of a weld of the following factors is discussed and illustrated : fusibility and composition of welding rod, nature of alloying elements, steadiness of arc, strength of current, alternating or direct current, composition of the flame in gas-welds, nature of electrode coating, if any, such subsequent processes as " burning-off," and the heat-treatment of welds with or without additional mechanical treatment. Effects of the latter are tabulated. The effects of welding of various types on the neighbouring material are described and illustrated.—P. M. C. R.

Stress Distribution in Welded Joints with Special Reference to Boilers. Kochendörffer (*Autogene Metallbearbeitung*, 1932, **25**, 5–12).—In such applications as boiler engineering, the most important problems presented by welded joints are those of the heat distribution due to welding and the danger of " notch effect." Experiments with the Hele-Shaw apparatus producing stream-lines constrained to follow the shape of typical weld-sections give qualitative results only, but serve to show that certain types of filler, especially concave, produce regions of high stress under tensile loading. It is emphasized that quantitative deductions from these experiments are not safe. Confirmation of the quantitative deductions is attempted by stress analysis and etching with Fry's reagent on model test-pieces.—H. W. G. H.

The Distribution of Stress in Fillet-Welds. G. N. Borrow (*Welder*, 1932, **3**, (27), 33–36).—Reviews the present position of research on this subject.—H.

Fundamental Research Problems in Welding. Anon. (*J. Amer. Welding Soc.*, 1932, **11**, (2), 5–7).—A classified list of problems of fundamental interest, compiled by the Fundamental Research Committee of the American Bureau of Welding.—H. W. G. H.

General Survey of Welding Processes. F. T. Llewellyn (*Amer. Soc. Test. Mat. Symposium on Welding*, 1931, 7–22; and (summary) *Amer. Machinist*

(*Eur. Edn.*), 1931, 74, 695).—Welding processes are classified and their technique briefly described. The field of use of each process and the physical properties of the welded product are discussed.—H. W. G. H.

Electric Welding. Marcel Mathieu (*Bull. Soc. Franç. Elect.*, 1931, [v], 1, 810–845; discussion, 1932, [v], 2, 256–261).—A survey of electric welding practice, covering, nature and sources of current, methods of welding (arc, hydrogen arc, resistance, and spot welding), types of machinery, applications of arc and resistance welding, and testing of welds. Special attention is given to the questions of electrical supply and to welding machines, especially those with automatic control.—P. M. C. R.

Atomic Hydrogen Welding. G. W. Akimov (*Tehnika Vosdushnogo Flota* (*Technics of the Aerial Navy*), 1931, 5, (1), 28–33).—[In Russian.] A brief description of the process and its applications, based on information obtained during a technical visit abroad.—N. A.

Arcogen : The Combined Gas-Electric Welding Process. H. Münter (*Autogene Metallbearbeitung*, 1930, 23, 349–356, 365–373; and (summary) *Welding News*, 1931, 2, 3).—In praise of the process.—H. W. G. H.

Electric Welding by Means of High-Frequency Alternating Current. F. Kisliuk (*Elektrichestvo* (*Electricity*), 1932, (4), 226–231).—[In Russian.] The feasibility of electric welding with a frequency of 200–500 cycles/second is discussed. The method is specially valuable for welding iron of narrow-cross-section and copper with carbon electrodes, the strength of the welded seam being apparently considerable. With a frequency of 500 cycles/second welding can be carried out with naked electrodes.—N. A.

Some Resistance Welding Problems. C. L. Pfeiffer (*J. Amer. Weld. Soc.*, 1931, 10, (4), 5–11; and (abstract) *Welding Eng.*, 1931, 16, (5), 35–38; (6), 42–45).—There are at least 11 factors to be considered and co-ordinated in making a resistance welded joint, and these are dealt with in detail in relation to the welding of multiple sheets and to plated parts. The problem of welding dissimilar metals is considered and the requirements for balanced conditions are discussed. Examples are given of spot welding precious metals, butt-welding Permalloy wire under carbon tetrachloride and butt-welding copper rod and wire.—J. H. W.

The Electric Arc and its Application to Welding. C. Leonard (*Bull. Soc. Franç. Elect.*, 1931, [v], 1, 938–955; 1932, [v], 2, 133–150; discussion, 264–265).—(I). The electric arc is considered as a means of transforming electrical energy into heat, light, or energy of other types. The conduction of electricity through metals, electrolytes, and gases is reviewed, and brief consideration is given to thermionic discharge, fall of anodic potential, and the minimum intensity necessary to maintain the arc. (II). Arc welding with a metallic electrode is described, with a discussion of the influence on the arc of electrode position, of voltages and current density, of atmosphere and of electrode coating. The nature and stability of the arc both with a.c. and d.c. are discussed. Polyphase arcs are briefly considered, and a description and analysis of the atomic hydrogen welding process are given.—P. M. C. R.

The Sources of Current Supply to the Arc in Rod Welding, Especially with Direct Current. J. Berger (*Bull. Soc. Franç. Elect.*, 1931, [v], 1, 856).—After a discussion of the part played by the arc in welding of this type, B. states shortly the necessary characteristics of a satisfactory current supply. Types of generator are then described and illustrated.—P. M. C. R.

On the Promotion of the Skill of Welders in Electric Arc Welding. Y. Nishimura (*Journal of Zosen Kiokai* (*Society of Naval Architects of Japan*), 1932, 49, 95–106).—[In Japanese.] Deals with the training of welders, the necessary equipment and tests for the qualification of those under training.

—S. G.

A Full Automatic Welding Head. Anon. (*Tram. and Rail. World*, 1931, **69**, 205).—It is claimed that the Weldomatic machine can be used on repair or repetition work requiring a straight-line weld. It consists of automatically controlled head, operator's panel, and motor-generator set. Changes in arc voltage are amplified in transmission to the motor, which therefore responds to any alterations with increased sensitiveness. The automatic feed of electrode wire is controlled by this device. Electrode nozzles are of the split type, wear being reduced by local Stelliting.—P. M. C. R.

Modern Welding Machines and their Applications. Paul Neumayer (*Bull. Soc. Franç. Elect.*, 1931, [v], **1**, 846–855; discussion, 1932, [v], **2**, 261–264).— The main types of resistance and arc welding are briefly enumerated, and the corresponding machinery is described and illustrated. Some recent applications of welding are given, with some emphasis on the tendency to replace castings by welded structures.—P. M. C. R.

The Storage of Acetylene. H. Grohmann (10e. *Congrès internat. acétylène*, 1930, 192–203; *Chim. et Ind.*, 1932, **27**, 1059–1060; *C. Abs.*, 1932, **26**, 4444).— A discussion of the hazards of acetylene stored in solution in methyl ketone. The presence of a porous absorbent was generally considered to prevent or retard propagation of decomposition throughout the mass of dissolved acetylene, but G.'s investigation disproved this supposition.—S. G.

XXI.—INDUSTRIAL USES AND APPLICATIONS

Aluminium as a Can Material. Gulbrand Lunde (*Tids. Hermetikind.*, 1932, **18**, (6), 169–179; and (abstract) *Aluminium Broadcast*, 1932, **3**, (37), 25; *C. Abs.*, 1932, **26**, 4656).—The advantages of aluminium as a can material are that there is no blackening, no metallic odour or taste, no solution of injurious metals, easy opening, and lighter cans.—S. G.

Preliminary Report on the Work of the Packing Industry Laboratory [Aluminium as a Packing Material]. Gulbrand Lunde (*Tids. Hermetikind.*, 1931, **17**, (12), 331–335; *C. Abs.*, 1932, **26**, 4656).—Deals, among other matters, with aluminium as a packing material.—S. G.

The Use of Aluminium in [Apparatus for] Hydrogenation and the Patent Protection of the Apparatus. Geo. Weissenberger (*Petroleum Z.*, 1932, **28**, (34), 8–9).—S. G.

Tank Cars for the Chemical and Allied Industries. —— Karsten (*Maschinenkonstrukteur*, 1931, **64**, 206–208).—Applications and design of tank cars are considered. The use of aluminium foil for heat-insulation appears to be increasing. A tank for transporting acetic acid is illustrated; it is constructed from aluminium sheet, and carries an aluminium heating coil.—P. M. C. R.

Heavy Electric Traction Progress in America. Charles Kerr, Jr. (*Tram. and Rail. World*, 1931, **69**, 187–190).—In certain multiple-unit motor-rail cars the use of aluminium in car-body and equipment has effected considerable economy in weight with consequent increase in carrying power. Commutator covers, terminal boxes, and axle caps are now made of aluminium, which has also been advantageously used in the control section.—P. M. C. R.

Insulation by Means of Metals. H. Niemann (*Wärme u. Kälte Tech.*, 1931, **33**, (7/8), 1–5; *C. Abs.*, 1932, **26**, 4392).—A discussion of the merits of an insulation formed of aluminium sheet 7 microns thick and crumpled to leave pores. The material weighs only 3 kg./m.³.—S. G.

Tentative Specifications for Aluminium-Base Alloy Die-Castings (B 85–31 T) —— (*Amer. Soc. Test. Mat. Tentative Standards*, 1932, 292–294).—See this *J.*, 1932, **50**, 103–104.—S. G.

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XXIV.—BOOK REVIEWS

[All books reviewed are contained in the Library of the Institute.]

Précis de Métallographie microscopique et de Macrographie. Par Léon Guillet et Albert Portevin. Troisième édition. Roy. 8vo. Pp. 407, with 647 illustrations. 1932. Paris : Dunod. (128 francs.)

This book, which has now reached its third edition, forms a valuable addition to the list of text-books on metallurgy and the reputation of its two authors renders it authoritative. It is a charming book to read ; the subject is presented in an interesting way and in language easily understood by a foreigner. It is profusely illustrated, the illustrations being admirably chosen, well prepared, and adequately reproduced.

The book commences with the discussion of the microscopic examination of metals and gives a detailed account of the preparation of material for such examination. No reference is made to the elegant and effective method, recently developed in America, which employs a microtome for the preparation of the surface. The equilibrium diagram and methods for its determination are discussed. No reference, however, is made to the use of X-rays. The mechanical properties of metals and alloys are then described. It is here surprising to find the statement that the fatigue test is of minor importance. A large section is devoted to iron and steel, with special reference to alloy steels. A further section is devoted to non-ferrous metals. A valuable and well-illustrated section is devoted to the macroscopic examination of metals, a subject which has recently suffered a period of partial eclipse from which it is now emerging.

An alphabetical index would form a valuable addition to the book.—J. D. GROGAN.

Gmelin's Handbuch der Anorganischen Chemie. Achte, völlig neu bearbeitete Auflage. Herausgegeben von der Deutschen Chemischen Gesellschaft. Bearbeitet von R. J. Meyer. System-Nummer 58 : **Kobalt.** Teil A, Lieferung 2. Pp. 221–502, illustrated (R.M. 48; subscription price, R.M. 42); System-Nummer 59 : **Eisen.** Teil B, Lieferung 5. Pp. 873–1166, illustrated. (R.M. 53.50; subscription price, R.M. 47.50.) Sup. Roy. 8vo. 1932. Berlin : Verlag Chemie, G.m.b.H.

The section, system number 58, deals with the derivatives of cobalt, exclusive of the ammines, in the manner adopted in the earlier sections. The compounds are dealt with in order, beginning with the compounds of cobalt and hydrogen which is followed by compounds with oxygen, the hydroxides, nitrides, azides, amide, hyponitrite, nitrites, nitrates, fluorides, chlorides, chlorates, perchlorates, bromides, bromates, iodides, iodates, periodates, sulphides, sulphites, sulphates, thiosulphates, dithionates, amidosulphonate, selenides, selenites, selenates, tellurides, tellurites, tellurates, borides, borates, carbides, carbonyls, carbonates, thiocarbonates, acetates, oxalates, tartrates, citrates, acetyl-acetonates, cyanides, cyanates, thiocyanates, silicides, silicates, phosphides, phosphates, arsenides, arsenates, stibides and complex compounds with compounds of other metals including bismuth, lithium, and the alkali metals, the alkaline-earth metals, zinc, cadmium, mercury, aluminium, titanium, zirconium, thorium, tin, lead, vanadium, columbium, chromium, tantalum, molybdenum, tungsten, uranium, manganese, and nickel. The properties, both chemical and physical of these compounds are described very fully and where organic complex compounds exist these are included. It is indeed difficult, if not impossible, to find a compound, into the composition of which cobalt enters, which has

been omitted. The present instalment completes a very full, useful, and accurate account of the chemistry of the element cobalt and its derivatives.

The B section of system number 59 is completed by the present instalment, which deals with the complex compounds of iron in which another metal is involved. The treatment is systematic, and commences with the lithium iron compounds, which are followed by iron compounds with compounds of the alkali metals, the alkaline-earth metals, zinc, cadmium, mercury, aluminium, gallium, indium, thallium, titanium, zirconium, thorium, tin, lead, vanadium, columbium, chromium, molybdenum, tungsten, uranium, manganese, nickel, and cobalt. Organic compounds of these complex derivatives, where such exist, are described, as well as compounds with ammonium salts, ammonia, and hydroxylamine.

The two sections under review maintain the high standard of excellence set up by the earlier sections. The work will prove a continuous source of satisfaction to chemists, and although the price of the whole work is prohibitive to many chemists individually, this work must find a place in all chemical libraries, since it presents the most complete account of our knowledge of inorganic chemistry.—JAMES F. SPENCER.

Die Abhängigkeit der Werkstoffdämpfung von der Grösse und Geschwindigkeit der Formänderung. Von Ernst Bankwitz. (Mitteilungen des Wöhler-Instituts, Braunschweig, Heft 11.) Demy 8vo. Pp. iv + 53, with 35 illustrations in the text. 1932. Berlin : NEM-Verlag G.m.b.H. (R.M. 3.60.)

This is an account of a research conducted at the Wöhler Institute, the three main objects of which may be summarized as follows : (1) to determine the extent of the damping effects with small changes of form; in the case of the light metals and other good thermal conductors the difficulties in making these determinations are great; (2) to determine the influence of the rate of change and form on the magnitude of the damping phenomena ; and (3) to investigate to what extent the static properties of materials are affected by alternating stresses.

It has been found that on the curves showing the damping characteristics of materials with low yield-points such as the light metals, copper, &c., the null point and the first portion of the curves cannot be satisfactorily determined; but by means of new diagrams showing the numbers of alternations in the tests and their relationship to damping effects the null point has been fairly accurately determined. Thermal measurements have confirmed these results. The latter part of the report deals with the raising of the yield-point by the application of alternating stresses.—W. A. C. NEWMAN.

Die Ferromagnetischen Legierungen und ihre Gerwerbliche Verwendung. Von W. S. Messkin, umgearbeitet und erweitert von A. Kussmann. Med. 8vo. Pp. viii + 418, with 292 illustrations in the text. 1932. Berlin : Julius Springer. (R.M. 44.50.)

The literature of the ferromagnetic alloys is extensive and scattered. The authors, in this volume, have collected together and summarized a good deal of this literature, more especially that relating to ferromagnetic alloys which have found, or may possibly find, industrial application, and have discussed their physical-chemical characteristics and internal structures. It can be said at once, that they have done their task well. The manuscript of the work, originally due to Messkin, and having a bias which would make the work invaluable to the steel-worker and electro-technician, was extended by Kussmann to include a discussion of the physical chemistry of these alloys. The resulting joint work will therefore appeal to a much wider circle of readers. The practical man, the student of physics or chemistry, the crystallographer, will all find something of interest here.

Chapters devoted to a brief account of magnetic quantities and their measurement are succeeded by a description of methods and apparatus available for testing materials used in the construction of permanent magnets. This is followed by chapters dealing with : the effects of chemical composition and condition on magnetic properties, magnetic analysis, characteristics of technological importance, including the effects of cold- and hot-working, steels used for the construction of permanent magnets, including alloy steels containing tungsten, chromium, molybdenum, cobalt, and copper, alloy steels for the construction of dynamos and transformers, and alloys having high magnetic saturation values. The whole is very well done. There is just one small point that may be somewhat confusing at first. In 1930 an international decision was reached that the unit of magnetic field strength, H should be called the " Oersted," and not, as formerly, the " Gauss." This latter name is now reserved for the unit of magnetic induction, usually denoted by B and equal to μH. In the text of this book, the " Oersted " is used for the unit of H, but as some of the diagrams had been completed before 1930, and as others are reproduced from the original papers in which they occur, this same unit of field strength, is, in most of the diagrams, called the " Gauss."

The book is very well printed on good paper; the diagrams and tables are extremely clear

(some of the equilibrium diagrams are models of distinctness which I would commend especially
to metallographers); it is provided with adequate name and subject indexes and is well bound.
I regret that I am unable to recommend it to a wide circle of buyers, as distinct from readers.
The book will undoubtedly find its way on to the shelves of our scientific and larger industrial
libraries and will often be taken down therefrom. But it will not be found in the more limited
libraries of students or researchers; and that is where it should be. Its price, about £3 at to-
day's rate of exchange, precludes that possibility. At best, student days are *short* days in more
ways than one. A reduction of price to, say, 25*s*., will secure for the book the wide circulation
it deserves.—J. S. G. Thomas.

Metal Aircraft Construction. By M. Langley. Demy 8vo. Pp. vii + 240,
  with 241 illustrations. 1932. London : Gale and Polden, Ltd., 2 Amen
  Corner, E.C.4. (15*s*. net.)

  The appearance of this small but well-filled book is a welcome event. It is intended for the
junior draughtsman, but it will prove of service to all who seek information on the use of metals
and alloys in aircraft construction. To readers interested in the materials used in modern air-
craft production, Chapter I on the development of metal aircraft, Chapter II on materials, and
Chapter VII on workshop processes and detail design should prove of special value. A brief
survey of the principal materials used in the construction of wings, fuselages, boat hulls, and
floats, undercarriages, &c., is given. To a specialist on a particular material of construction the
data given may appear, in certain instances, brief and rather superficial. The author has, how-
ever, given a good outline of the main points of the subject in a volume which, although small,
provides useful practical data not readily available elsewhere in collected form.—H. Sutton.

The Sorption of Gases and Vapours by Solids. By James William McBain.
  Demy 8vo. Pp. xii + 577, with 151 illustrations. 1932. London :
  George Routledge and Sons, Ltd. (25*s*. net.)

  The large mass of existing data dealing with this important subject has been collated for the
first time in the present book, and there is no doubt that the result of this formidable task will
be widely valued. Part 1 is introductory, dealing with historical and general features and
with methods of measurement. In Part 2 the available experimental data on various materials
are classified and discussed. Hypotheses and theories are briefly classified and finally discussed
separately in Part 3. This latter section, in common with the remainder of the book, is admir-
ably concise and clear. The classical thick compressed film theory is regarded by the author as
insufficiently supported in view of the necessity for the assumption of large range attractive
forces not yet shown to exist. The Langmuir theory, which postulates the inelasticity of the
collision between a molecule of gas and a solid, is regarded as more successfully fitting the facts.
According to this view, the complicated phenomena known as adsorption are primarily always
physical, other processes, chemical or physical, following.

  While the book is mainly for the pure physicist it is not altogether without interest for the
metallurgist. Numerous references are made in the text, and, in addition to the usual subject
index, a substance index and an author index are provided. Excellent printing of the text and
figures contributes to a valuable scientific reference volume.—R. Genders.

Refractories. By F. H. Norton. Roy. 8vo. Pp. x + 594, with numerous
  illustrations. 1931. New York : McGraw-Hill Publishing Co. Inc.
  London : McGraw-Hill Book Co. Ltd. (36*s*. net.)

  The subject of refractories is receiving increasing attention in these days and the publication
of a book on the subject is not without extreme interest, especially as good works on it are only
few in number. In this instance preference is given to American practice, especially in the
descriptions of manufacturing processes. Practically nothing is said on the important subject
of the proper use of refractories in furnace design and construction, this being too large a field,
according to the author, to be summarized in a volume of this nature. Attempts have been
made throughout to indicate directions in which profitable research might be conducted. In
the first chapter a review of the literature up to date is given and a record is made of biblio-
graphies in which the fullest information may be found. There follow three chapters which
deal with the various classes of primary refractories, their preliminary treatment, and their
plastic and moulding characteristics. The drying and burning of the clays and the ultimate
products demand special kilns, accurate temperature control, and a knowledge of theoretical
principles underlying these processes. These are fully discussed and illustrated in the next
series of chapters, and an attempt has been made to include the results from most of the recent
important investigations. Very naturally the mechanical, physical and chemical properties
of commercial refractories are given wide consideration in sections devoted to load bearing
capacity, spalling, reactions between refractories and glasses, expansion and shrinkage, heat
transmission, microscopic examination, X-ray studies, and chemical analysis. A short chapter

at the end is given over to a consideration of refractory cements and plastics. As a whole the book is thoroughly readable, modern in its outlook, and well balanced in its conception.

—W. A. C. NEWMAN.

Technische Elektrochemie. Band III.—Schmelzfluss-Elektrolyse Alkali-metalle, Erdalkalimetalle, Magnesium, Aluminium, Beryllium u.s.w. Von Jean Billiter. Zweite, umgearbeitete und vermehrte Auflage. Med. 8vo. Pp. vii + 196, with 72 illustrations. 1932. Halle (Saale): Wilhelm Knapp. (Br. M. 12.50; geb. M. 14.)

The extraction of the light metals from their ores has resulted mainly from the electrolysis of their molten salts, dissolved, in most instances, in other fused media. The importance to which these light alloys and the ever-increasing number of their useful alloys, have attained, has intensified the interest in methods for the extraction of the pure metals. The electrolysis of molten salts is therefore becoming a vitally important part of electrochemistry.

The introduction serves to enlighten the reader on various theoretical phases of the subject—ionization, dissociation, Faraday's law, electromotive force, decomposition potentials, &c. There follow seven chapters, each of which deals with the electrolytic separation of a particular metal. The following are included—sodium compounds, including the production of sodium, chlorine, and caustic soda; lithium and potassium; alkaline-earth metals; beryllium; magnesium, including the electrolysis of the chloride, and of the oxide in fluoride mixtures; aluminium, including the purification of bauxite, and the electrolysis of the molten oxide–fluoride mixtures; and cerium mixed metal. Although one or two errors have been detected, they do not detract from the general value of the book as a source of relatively detailed information on the various processes. Of particular interest are a number of the photographs which are new and up-to-date so far as ordinary text-book reproduction is concerned.—W. A. C. N.

Handbook for Electric Welders. Demy 8vo. Pp. 75, with 21 illustrations. [1932.] London: Murex Welding Processes, Ltd., Ferry Lane Works, Forrest Rd., Walthamstow, E.17. (1s. net.)

The first two chapters of this booklet attempt the difficult task of explaining electrical theory in simple language and, although successful to a certain extent, they have not been written with the easy confidence which is characteristic of the other chapters. They are followed by a brief outline of elementary ferrous metallurgy, an explanation of the behaviour of flux-coated electrodes in the arc, and concise instructions for beginners. The most valuable part of the booklet is perhaps the next three sections, on making a fillet-weld, making a butt-weld, and welding cast-iron. Each is written by a practical welder and gives detailed instructions in sound technique. Three shorter sections follow, on stainless steel, tramway, and non-ferrous welding. Of these, the first and last are disappointingly brief, and give little indication of the difficulties which may be expected. We should like to have much more information on the arc-welding of non-ferrous materials. A chapter on the mechanical and physical properties of weld metal (ferrous welds only being considered) is followed by a section on estimating quantities, which will be found invaluable by every foreman welder.

The booklet can be recommended to everyone interested in metallic arc welding; the fund of information it contains would be expanded, in the average text-book, to cover many dozens of pages and to cost many dozens of pence.—H. W. G. HIGNETT.

The Purox Manual. Instructions for Welding and Cutting by the Oxy-Acetylene Process. Second Edition. Med. 8vo. Pp. 150, with 89 illustrations in the text. 1931. New York: The Linde Air Products Co. ($1.00.)

The first five chapters of this book describe welding and cutting apparatus and accessories as manufactured by the publishers of this handbook. They are not, therefore, of great interest to a welder who wishes to use a blowpipe of different make. The sixth chapter gives concise practical instructions for oxygen cutting and the seventh introduces the sections on welding by explaining how the welder may recognize the materials he is likely to be called on to weld. Monel metal is among those mentioned, but nickel is unaccountably omitted. The next seven chapters deal with the welding of wrought and cast steel and iron, whilst the non-ferrous metals are surveyed in the last two chapters—" Welding Sheet Aluminium " and " Welding Cast Aluminium."

This book is written from a very narrow viewpoint; it fails to show any broad view of his art to a welding apprentice and it therefore fails to impress as a useful manual for his instruction. For example, although extremely detailed practical instructions are given throughout, no indication is given that there is more than one opinion as to the best method of blowpipe manipulation. Again, no account of any process can be complete without pointing out its limitations and defects in relation to other processes.—H. W. G. HIGNETT.

Foundations and Methods of Chemical Analysis by the Emission Spectrum. Being the Authorized Translation of " Die Chemische Emissionsspektral-analyse." By Walther Gerlach and Eugen Schweitzer. Med. 8vo. Pp. 123, with 53 illustrations. 1931. London : Adam Hilger, Ltd., 24 Rochester Place, Camden Rd., N.W.1. (12s. 6d. net.)

In this book the authors summarize and amplify their work on the application of emission spectra to the qualitative and quantitative analysis of metals and alloys with special reference to the method of homologous pairs of lines. The book commences with a discussion of the nature, application, and basic principles of chemical spectrum analysis, then passes to a description of the electrical and optical apparatus employed in the work, and finally to a consideration of methods of qualitative and quantitative spectrographic analysis, in which is included an account of experiments on the refinement of the method by photometric intensity measurements. A brief bibliography of the most important papers covering the subject concludes the book ; most of these papers have already been abstracted in this *Journal*, and reference to them will more fully indicate the nature of the subject-matter of this book.

After many years' experience in this type of spectrographic analysis, the authors have come to the conclusion that the method offers considerable advantages over chemical analysis for the detection and determination of small quantities of impurities in metals and alloys. Whether this be true in all cases or not, the fact remains that their work has aroused very considerable interest in the metallurgical world, and metallurgists are under a debt of gratitude to them for this admirably lucid exposition of the results of their researches, which should enable others to repeat, expand, and amplify the work. The translation has been done very well indeed, the publishers have produced the book in good, clear type, and the illustrations are excellent. The book can be thoroughly recommended to all who desire to gain a thorough knowledge of this fascinating branch of analysis.—A. R. POWELL.

Die Massanalyse. Zweiter Teil : Die Praxis der Massanalyse. Von I. M. Kolthoff, unter Mitwirkung von H. Menzel. Zweite Auflage. Post 8vo. Pp. xi + 612, with 23 illustrations. 1931. Berlin : Julius Springer. (Geh., R.M. 28 ; geb., R.M. 29.40.)

That a second edition of this book is required within three years of the publication of the first edition testifies to its value as a text-book of analytical chemistry. The style and scope of the work have already been fully discussed in the review of the first edition which appeared in this *Journal* (1928, **39**, 720). In preparing this edition the author has considerably extended the field covered, to include all the latest advances made in analytical chemistry up to and including the early part of 1931, and in order to do this without making the book unwieldy, details of analytical procedure and the critical discussions of the methods are printed in smaller type ; nevertheless, this edition contains exactly 100 pages more than the last. Among the additions may be mentioned the use of ceric sulphate instead of permanganate for oxidimetric titrations and the determination of various common and rare metals by bromometric titration of their compounds with 8-hydroxyquinoline. The book is again well supplied with references as footnotes, and thus provides an exhaustive survey of modern analytical technique ; there is no doubt that this new edition is the foremost textbook on chemical analysis, and English-speaking chemists will look forward to the second English translation.—A. R. POWELL.

Rechenverfahren und Rechenhilfsmittel mit Anwendungen auf die Analytische Chemie. Von Otto Liesche. (" Die Chemische Analyse." Herausgegeben von Wilhelm Böttger. XXX Band.) Roy. 8vo. Pp. viii + 201, with 24 illustrations. 1932. Stuttgart : Ferdinand Enke. (Geh., R.M. 20 ; geb., R.M. 22.)

This is a useful little book not only for advanced chemical students, but for all analytical chemists ; it consists of a series of practical hints on mathematical calculations and their application to working out analytical results from the figures obtained both in direct and in indirect analysis. The first section contains a description of rapid methods of adding, subtracting, multiplying, and dividing, and shows how many apparently complicated mathematical operations can be made mentally after memorizing a few simple rules. Section II discusses the use of logarithms and the construction and use of slide rules and calculating machines. In Section III examples are given of methods of working out results from the figures obtained in all kinds of analytical operations, and, finally, the last section describes the construction and use of nomograms.

The book is very well written, and makes interesting reading ; probably there are very few analysts who will not find something of value to themselves in the book.—A. R. POWELL .